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IDENTIFIERS Diving; Marine Equipment; Marine Occupations; Military Curriculum Project; *Scuba Divers

ABSTRACT

This curriculum outline, student guide, and instructor guide for a secondary-postsecondary-level course in scuba diving (diver second class) is one of a number of military-developed curriculum packages selected for adaptation to vocational instruction and curriculum development in a civilian setting. Purpose stated for the 425-hour course is to provide training necessary to perform operational activities and maintain open circuit scuba surface supplied air diving equipment and related accessories/equipment as a member of a team. The plan of instruction suggests number of lessons and hours of classroom and laboratory time for twelve units: Physical Conditioning, Diving Physics, Medical Aspects of Diving, Open Circuit Scuba Diving, Diving Orientation, Underwater Basic, Underwater Advanced, Lightweight Diving, Underwater Tools, Underwater Cutting and Welding, Diving Equipment Repair, and Hyperbaric Chamber. The curriculum outline describes objectives and lesson duration and lists equipment needs and references. Contents of the student guide include objectives and information, assignment, job, and notetaking sheets. The instructor guide contains objectives, outline of instruction, and student and instructor activities. An additional military diving manual is recommended with the note that it may be obtained from the Government Printing Office. The course could be used in a group situation or adapted for individual study. (YLB)

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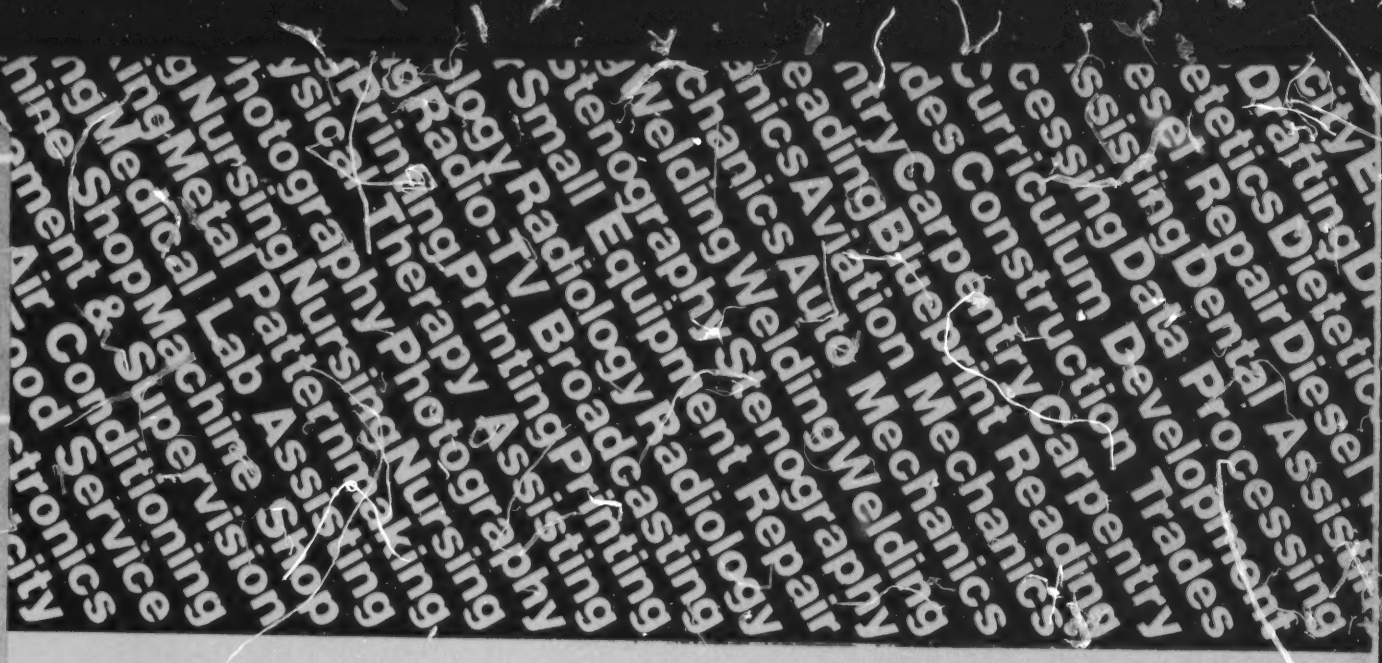

Military Curricula for Vocational & Technical Education

BEST COPY AVAILABLE

CE 024 379

U.S. DEPARTMENT OF HEALTH EDUCATION & WELFARE NATIONAL INSTITUTE OF EDUCATION

• DIVER SECOND CLASS

15-3

THE NATIONAL CENTER FOR RESEARCH IN VOCATIONAL EDUCATION
THE OHIO STATE UNIVERSITY

This military technical training course has been selected and adapted by The Center for Vocational Education for "Trial Implementation of a Model System to Provide Military Curriculum Materials for Use in Vocational and Technical Education," a project sponsored by the Bureau of Occupational and Adult Education, U.S. Department of Health, Education, and Welfare.

MILITARY CURRICULUM MATERIALS

The military-developed curriculum materials in this course package were selected by the National Center for Research in Vocational Education Military Curriculum Project for dissemination to the six regional Curriculum Coordination Centers and other instructional materials agencies. The purpose of disseminating these courses was to make curriculum materials developed by the military more accessible to vocational educators in the civilian setting.

The course materials were acquired, evaluated by project staff and practitioners in the field, and prepared for dissemination. Materials which were specific to the military were deleted, copyrighted materials were either omitted or approval for their use was obtained. These course packages contain curriculum resource materials which can be adapted to support vocational instruction and curriculum development.

The National Center Mission Statement

The National Center for Research in Vocational Education's mission is to increase the ability of diverse agencies, institutions, and organizations to solve educational problems relating to individual career planning, preparation, and progression. The National Center fulfills its mission by:

- Generating knowledge through research
- Developing educational programs and products
- Evaluating individual program needs and outcomes
- Installing educational programs and products
- Operating information systems and services
- Conducting leadership development and training programs

FOR FURTHER INFORMATION ABOUT
Military Curriculum Materials
WRITE OR CALL

Program Information Office
The National Center for Research in Vocational Education
The Ohio State University
1960 Kenny Road, Columbus, Ohio 43210
Telephone: 614/486-3655 or Toll Free 800/848-4815 within the continental U.S. (except Ohio)

THE NATIONAL CENTER FOR RESEARCH IN VOCATIONAL EDUCATION

The Ohio State University, 1960 Kenny Road, Columbus, Ohio 43210
Tel. (614) 486-3655 Cable: CTVOCEDOSU Columbus, Ohio

Military Curriculum Materials for Vocational and Technical Education

Information and Field Services Division

The National Center for Research in Vocational Education

Military Curriculum Materials Dissemination Is . . .

an activity to increase the accessibility of military-developed curriculum materials to vocational and technical educators.

This project, funded by the U.S. Office of Education, includes the identification and acquisition of curriculum materials in print form from the Coast Guard, Air Force, Army, Marine Corps and Navy.

Access to military curriculum materials is provided through a "Joint Memorandum of Understanding" between the U.S. Office of Education and the Department of Defense.

The acquired materials are reviewed by staff and subject matter specialists, and courses deemed applicable to vocational and technical education are selected for dissemination.

The National Center for Research in Vocational Education is the U.S. Office of Education's designated representative to acquire the materials and conduct the project activities.

Project Staff:

Wesley E. Budke, Ph.D., Director
National Center Clearinghouse

Shirley A. Chase, Ph.D.
Project Director

What Materials Are Available?

One hundred twenty courses on microfiche (thirteen in paper form) and descriptions of each have been provided to the vocational Curriculum Coordination Centers and other instructional materials agencies for dissemination.

Course materials include programmed instruction, curriculum outlines, instructor guides, student workbooks and technical manuals.

The 120 courses represent the following sixteen vocational subject areas:

- Agriculture
- Aviation
- Building & Construction Trades
- Clerical Occupations
- Communications
- Drafting
- Electronics
- Engine Mechanics
- Food Service
- Health
- Heating & Air Conditioning
- Machine Shop
- Management & Supervision
- Meteorology & Navigation
- Photography
- Public Service

The number of courses and the subject areas represented will expand as additional materials with application to vocational and technical education are identified and selected for dissemination.

How Can These Materials Be Obtained?

Contact the Curriculum Coordination Center in your region for information on obtaining materials (e.g., availability and cost). They will respond to your request directly or refer you to an instructional materials agency closer to you.

CURRICULUM COORDINATION CENTERS

EAST CENTRAL
Rebecca S. Douglass
Director
100 North First Street
Springfield, IL 62777
217/782-0759

NORTHWEST
William Daniels
Director
Building 17
Airdustrial Park
Olympia, WA 98504
206/753-0879

MIDWEST
Robert Patton
Director
1515 West Sixth Ave.
Stillwater, OK 74704
405/377-2000

SOUTHEAST
James F. Shill, Ph.D.
Director
Mississippi State University
Drawer DX
Mississippi State, MS 39762
601/325-2510

NORTHEAST
Joseph F. Kelly, Ph.D.
Director
225 West State Street
Trenton, NJ 08625
609/292-6562

WESTERN
Lawrence F. H. Zane, Ph.D.
Director
1776 University Ave.
Honolulu, HI 96822
808/948-7834

DIVER SECOND CLASS

Classroom Course 15-3

A-433-0022

Developed by:

United States Navy

Development and Review Dates:

March 1976

Occupational Area:

Meterology, Navigation, Maritime Occupations

Target Audiences:

Grade 11 - Adult

Print Pages: 1701

Microfiche: 29

Availability:

Vocational Curriculum Coordination Centers

Contents:	Type of Materials: Lesson Plans:	Programmed Text:	Student Workbook:	Handouts:	Text Materials:	Audio-Visuals:	Instructional Design: Performance Objectives:	Tests:	Review Exercises:	Additional Materials Required:	Type of Instruction: Group Instruction:	Individualized:	
Unit 1.0-Physical Conditioning	•		•				•		•	x	•		
Unit 2.0-Diving Physics	•		•		x		•		•	x	•		
Unit 3.0-Medical Aspects of Diving	•		•		x		•		•	x	•		
Unit 4.0-Open Circuit SCUBA Diving	•		•		x	x	•		•	x	•		
Unit 5.0-Diving Orientation	•		•		x	x	•		•	x	•		
Unit 6.0-Underwater Basic	•		•		x		•		•	x	•		
Unit 7.0-Underwater Advanced	•		•		x		•		•	x	•		
Unit 8.0-Lightweight Diving	•		•		x		•		•	x	•		
Unit 9.0-Underwater Tools	•		•		x	x	•		•	x	•		
Unit 10.0-Underwater Cutting and Welding	•		•		x	x	•		•	x	•		
Unit 11.0-Diving Equipment Repair	•		•		x		•		•	x	•		
Unit 12.0-Hyperbaric Chamber	•		•		x		•		•	x	•		

X Materials are recommended but not provided.

Course Description:

This course is designed to provide training necessary to perform operational activities and maintain open circuit SCUBA surface supplied air diving equipment and related accessories/equipment as a member of a team. The course consists of 12 units requiring 425 hours of instruction.

Unit 1.0- Physical Conditioning contains one lesson covering 60 hours of instruction.

Unit 2.0- Diving Physics consists of 2 lessons covering 30 hours of instruction.
- Decompression Charting (24 hours)
- Diving Formulas (6 hours)

Unit 3.0-Medical Aspects of Diving is composed of 6 lessons requiring 30 hours of instruction.
- Resuscitation (1 hour)
- Hemmorhage and Shock Treatment (1½ hours)
- First Aid Treatment (5½ hours)
- Diving Disease/Injury Treatment (21 hours)
- Dangerous Marine Life (1 hour)

Unit 4.0-Open Circuit Scuba Diving includes 10 lessons covering 62 hours of instruction.
- Visual Signals (½ hour)
- SCUBA Inspection and Maintenance (14 hours)
- Open Circuit SCUBA Charging (1½ hours)
- Planning (1 hour)
- Surface and Compass Swims (10 hours)
- Clearing, Ditching, and Donning Open Circuit SCUBA (17 hours)
- Night Bottom Search (8 hours)
- Underwater Hull Inspection (7 hours)
- General Safety Precautions (3½ hours)

Unit 5.0- Diving Orientation contains 3 lessons requiring 30 hours of instruction.
- MK V Deep Sea Diving System (5 hours)
- MK V Deep Sea Diving System Diver (11 hours)
- MK V Deep Sea Diving System Tender (13 hours)

Unit. 6.0- Underwater Basic consists of 3 lessons covering 30 hours of instruction.
- MK V Deep Sea Diving System (5 hours)
- MK V Deep Sea Diving System Diver (12½ hours)
- MK V Deep Sea Diving System Tender (12½ hours)

Unit 7.0- Underwater Advanced has 3 lessons requiring 30 hours of instruction.
- Pre-Dive Check List (9 hours)
- MK V Deep Sea Diving System Diver (11 hours)
- MK V Deep Sea Diving System Tender (10 hours)

Unit 8.0- Lightweight Diving contains 3 lessons covering 30 hours of instruction.
- Lightweight Diving System and Diver (18 hours)
- Clayton Diving Heater System (12 hours)

Unit 9.0- Underwater Tools consists of one lesson covering 30 hours of instruction.

Unit 10.0- Underwater Cutting and Welding contains one lesson requiring 30 hours of instruction.

Unit 11.0- Diving Equipment Repair contains 5 lessons concerning the MK V Deep Sea Diving System which require 30 hours of instruction.
- Helmet and Dress (14 hours)
- Umbilical (5 hours)
- Non-Return Valve (5½ hours)
- Air Control Valve (5½ hours)

Unit 12.0- Hyperbaric Chamber has one lesson requiring 30 hours of instruction.

Course Description: (continued)

This course contains both teacher and student materials. The printed instructor materials include a curriculum outline describing objectives and lesson duration, and an instructional guide containing objectives, outline of instruction, and student and instructor activities. The student guide contains information, assignment, job, and notetaking sheets.

An additional military diving manual is recommended but not provided. This course could be used in a group situation or adapted for individual study.

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* The student guide is arranged in Volumes A to L which generally correspond to the sequence of the units. However, Volume A contains Units 1.0 and 5.0. Unit 6.0 is contained in Volume C.

INFORMATION SHEET*

Support Materials for Diver Second Class, 15-3

U.S. Navy Diving Manual (Air Diving). Vol. 1 NAVSHIPS 0994-001-9010. Reprint 1977 ($10.00)

U.S. Navy Diving Manual (Mixed-Gas Diving). Vol. 2 NAVSHIPS 0994-001-9010. Reprint 1977 ($8.00)

For Sale by Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. (Also available at regional GPO Bookstores.)

*Please attach to paper copy of the course.

CURRICULUM OUTLINE
FOR
DIVER
SECOND CLASS

A-433-0022

CNTT-A60

2

CURRICULUM OUTLINE

FOR

DIVER SECOND CLASS

PREPARED BY

NAVAL SCHOOL, DIVING & SALVAGE
WASHINGTON NAVY YARD
WASHINGTON, D. C. 20374

A-433-0022

PREPARED FOR

SERVSCOLCOM, SAN DIEGO, CALIFORNIA
NAVSUBTRACENPAC, PEARL HARBOR, HAWAII
HCUTWO, NORFOLK, VIRGINIA
U. S. NAVSHIPREPFAC, SUBIC BAY, P. I.

8 MARCH, 1976

COVER PAGE

1. Course Title

   Diver Second Class

2. Course Length:

   425 Contact Hours

   12 Weeks

3. Locations at which taught:

   Service Schools Command, San Diego, CA

   Naval Submarine Training Center, Pacific
   Pearl Harbor, Hawaii

   Harbor Clearance Unit Two, Norfolk, VA

   U.S. Navy Ship Repair Facility, Subic Bay,
   Republic of Philippines

4. Class capacity:

   Normal 16

   Maximum 30

   Minimum 8

5. Instructors required per class based
   on normal capacity:

   4 for Laboratory Units

6. Activity Preparing Curriculum Outline

   Naval School, Diving and Salvage, Washington

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QUALIFICATION FACTORS FOR DIVER SECOND CLASS:

1. Knowledge of diving physics; effects of pressure; underwater physiology and medicine, including first aid.

2. Understand the theory and practice of decompression and use of the decompression tables.

3. Know the nomenclature of air diving equipment and the function of component parts.

4. Dress and tend divers properly.

5. Know all diving signals.

6. Maintain all diving logs and sheets.

7. Test, repair and adjust all air diving equipment and determine whether it is safe for use.

8. Know the operation of and preventive maintenance concerning all air diving equipment such as, compressors, hoses, helmets, suits, and open circuit SCUBA. (PMS)

9. Know the methods and procedures employed in searching for and recovering objects from the ocean.

10. Know the nomenclature of and be able to operate properly a recompression chamber.

11. Demonstrate practical application of marlinspike seamanship to diving operations.

12. Know the contents and use of Volume I, U.S.Navy Diving Manual.

13. Properly use underwater cutting and welding procedures.

14. Meet all requirements of a qualified SCUBA Diver.

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COURSE MISSION:

The Diver Second Class Course is designed to provide personnel with the training necessary to perform operational activities and maintain open circuit SCUBA surface supplied air diving equipment and related accessories/equipment as a member of a team Operations may be performed from surface or subsurface vessels ship repair facilities or other selected shore installations as necessary dependent upon organizational missions and commander's requirements.

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UNIT 1.0 PHYSICAL CONDITIONING

Contact Hours Allotted this Unit

Classroom	Laboratory
2 Hours	58 Hours

TERMINAL OBJECTIVES:

Supported Entirely by this Unit:

1. When the student completes this course he will have achieved and maintained a level of physical conditioning sufficient to allow him to participate, without undue stress, in diving training activities.

LESSON TOPIC 1.1 PHYSICAL CONDITIONING

Contact Hours Allotted this Lesson Topic:

Classroom	Laboratory
2 Hours	58 Hours

TERMINAL OBJECTIVES:

Supported entirely by this lesson topic:

1. From previous page.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. During the first week of physical training RUN continuously for five minutes and PERFORM five repetitions of each of the exercises contained in the terminal objective.

2. During the second week of physical training, RUN continuously for ten minutes and PERFORM ten repetitions of each of the exercises contained in the terminal objective.

3. During the third week of physical training RUN continuously for fifteen minutes and PERFORM fifteen repetitions of each of the exercises contained in the terminal objective.

4. During the fourth and subsequent weeks of physical training, RUN continuously for twenty minutes and PERFORM twenty repetitions of each of the exercises contained in the terminal objectives.

UNIT 2.0 DIVING PHYSICS

Contact Hours Allotted this Unit:

Classroom	Laboratory
30 Hours	0 Hours

TERMINAL OBJECTIVES:

Supported Entirely by this Unit:

1. When the student completes this course he will be able to, given the following diving situations: Normal working dive to include depth, job, bottom time and water decompression; normal working dive to include depth, job, bottom time, and surface decompression; and normal working dive to include depth, job, bottom time and surface decompression, 02. Perform necessary computations correctly, select proper descent/ascent rates, select proper decompression schedules and, using the information, complete the Diving Chart and, if applicable, repetitive dive worksheet.

2. When the Student completes this course he will be able to, given a diving situation and a sheet containing formulas used in diving, select the applicable formula(s) and solve the problem posed in the situation.

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LESSON TOPIC 2.1 DECOMPRESSION CHARTING

Contact Hours Allotted this Lesson Topic:

Classroom	Laboratory
24 Hours	0 Hours

TERMINAL OBJECTIVES

Supported entirely by this Lesson Topic:

1. When the student completes this course, he will be able to, given the following diving situation: Normal working dive to include depth, job, bottom time, and water decompression; Normal working dive to include depth, job, bottom time and surface decompression; and normal working dive to include depth, job, bottom time and surface decompression, 02. Perform necessary computations correctly, select proper descent/ascent rates, select decompression schedules and, using the information, complete the Diving Chart and, if applicable, Repetitive Dive Worksheet.

ENABLING OBJECTIVES

When the student completes this Lesson Topic, he will be able to:

1. DEFINE and DESCRIBE, in writing, terms used in Diving Physics.

2. DESCRIBE, in writing, the following as to how they affect the diver underwater:

   a. Boyle's Law
   b. Charles' Law
   c. Dalton's Law
   d. Henry's Law
   e. Heat transfer
   f. Sound transmission
   g. Light refraction

3. Decompression schedules:

   a. Orally LIST the name of each table in air and 02 decompression.

   b. Orally EXPLAIN the application of the Repetitive Dive Worksheet, recompression chamber, breathing medias, depth gauges and time pieces.

   c. DESCRIBE, in writing, how the use of various diving equipment affects decompression.

LESSON TOPIC 2.1 (Continued)

ENABLING OBJECTIVES

d. DEFINE, in writing, selected terms as used in air decompression.

e. DESCRIBE, orally, the sequence of computation for determining the decompression schedule for a repetitive dive.

f. DESCRIBE, orally, the sequence of computation for determining the selection of the proper decompression schedule and the rate of ascent to the first stop.

g. Orally EXPLAIN the need for decompression and decompression schedules.

h. Orally DESCRIBE the conditions under which the need for additional decompression other than that computed would be used.

i. Orally EXPLAIN the limits imposed by the utilization of oxygen for decompression.

j. Orally DESCRIBE the fundamentals involved in decompression when high altitude diving.

k. DESCRIBE, in writing, the most vital requirement of breathing media composition, depth and time.

l. Orally DESCRIBE the basic types of decompression tables.

m. Navy Decompression Tables (Air) System.

(1) For the following:

(a) Decompression Procedures.
(b) Standard Air Decompression Schedules.
(c) No-Decompression Limits.
(d) Surface Interval Credit.
(e) Repetitive Dive Time Table.
(f) Exceptional/Extreme Exposure.
(g) Surface Decompression Using Air.
(h) Nitrogen-Oxygen Equivalent Air Depth TAble.
(i) Nitrogen-Oxygen Equivalent Exceptional Exposure.

LESSON TOPIC 2.1 (Continued)

(j) Surface Decompression Using O_2.
(k) Oxygen Depth Time Limits.
(l) Diving Charts.

(2) Orally EXPLAIN the function(s), source of information required for use, and a description of the component.

(3) Orally DESCRIBE the physical location of each component part (section) within the major component part.

(4) Orally DESCRIBE how each component contributes to the control accomplished by the use of the decompression schedule system.

(5) WORK, in writing, a hypothetical dive using the Standard Decompression Schedule.

(6) WORK, in writing, a repetitive dive using the Repetitive Dive Worksheet.

(7) WORK, in writing, a surface decompression dive using oxygen.

(8) WORK, in writing, a surface decompression dive using air.

(9) Orally DESCRIBE the use of the Nitrogen Air Equivalent Air Depth Table.

(10) Orally DESCRIBE the use of the Oxygen Partial Limits and Oxygen Depth Time Limit.

(11) Given the maximum depth/time limits for each component and the maximum partial pressure limits, STATE, in writing, the set point(s) in terms of the effects of operating above or below them.

LESSON TOPIC 2.2 DIVING FORMULAS

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
6 Hours	0 Hours

TERMINAL OBJECTIVES

Supported entirely by this lesson topic:

1. When the student completes this course he will be able to, given a diving situation and a sheet containing formulas used in diving, select the applicable formula(s) and solve the problem posed in the situation.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. Orally EXPLAIN the meaning of all symbols used in diving formulas.

2. Orally EXPLAIN the application and use of all diving formulas.

3. DESCRIBE, in writing, the sequence of computation for determining:

   a. The area of a square/rectangle.
   b. The area of a circle.
   c. The volume of a cube.
   d. The volume of a sphere.
   e. The volume of a cylinder.
   f. Lifting capacity in fresh water (in pounds).
   g. Lifting capacity in salt water (in pounds.)
   h. Compressor output (minimum).
   i. Over bottom pressure requirements.
   j. Cut off depth.
   k. Maximum oxygen percent.
   l. Effective atmosphere.
   m. Partial pressure of a gas (in PSI).
   n. Volume left after falling (squeeze).
   o. Volume increase after blow up (embolism).
   p. Emergency hose test.

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UNIT 3.0 MEDICAL ASPECTS OF DIVING

Contact Hours Allotted this Unit:

Classroom	Laboratory
28 Hours	2 Hours

TERMINAL OBJECTIVES:

Supported Entirely By This Unit

1. When the student completes this course he will be able to demonstrate proper procedures for the application of mouth-to-mouth and mechanical (AMBU) resuscitation.

2. When the student completes this course he will be able to demonstrate the treatment of hemorrhage through the utilization of direct pressure methods.

3. When the student completes this course he will be able to demonstrate the first aid treatment for victims of shock.

4. When the student completes this course he will be able to, given a hypothetical case requiring first aid treatment, describe, in a sequence of steps, appropriate action. Include, as a minimum, name of injury/condition, treatment and post-treatment actions.

5. When the student completes this course he will be able to, given a hypothetical case involving a disease injury/condition common to diving, describe in a sequence of steps, appropriate action. Include, as a minimum, name of disease/injury conditions, selection of proper treatment table, if appropriate, treatment and post-treatment actions. If treatment tables are necessary, make correct log entries.

6. When the student completes this course he will be able to, given pictures/illustrations of marine life, identify with correct name, describe danger (if any) to divers, and describe, in a sequence of steps, appropriate medical actions and precautions to avoid contact.

LESSON TOPIC 3.1 RESUSCITATION

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
1/2 Hours	1/2 Hours

TERMINAL OBJECTIVES

Supported Entirely by this Lesson Topic:

1. When the student completes this course he will be able to demonstrate proper procedures for the application of mouth-to-mouth and mechanical (AMBU) resuscitation.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. Orally DESCRIBE emergency situations in which artificial respiration/resuscitation would be used.

2. Orally EXPLAIN the necessity for maintaining free unobstructed airway while administering artificial respiration/resuscitation.

3. Orally EXPLAIN the procedures for proper administration of artificial respiration/resuscitation.

4. Orally DESCRIBE the use of the mouth-to-mouth method of artificial respiration/resuscitation using a plastic airway.

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LESSON TOPIC 3.2 HEMORRHAGE TREATMENT

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
1/2 Hours	0 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course, he will be able to demonstrate the treatment of hemorrhage through the utilization direct pressure methods.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. SHOW, by pointing, the major pressure points on the body.
2. Orally EXPLAIN the conditions that warrant the use of a tourniquet.
3. Orally STATE the danger of loosening a tourniquet.
4. Orally EXPLAIN the pressure point methods of treatment for a hemorrhage stressing areas of the body where the method is applicable.
5. Orally EXPLAIN the direct pressure method of treatment of hemorrhage stressing areas of the body where the method is applicable.

LESSON TOPIC 3.3 SHOCK TREATMENT

Contact Hours Allotted This Lesson topic:

Classroom	Laboratory
1/2 Hours	1/2 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course, he will be able to demonstrate the first aid treatment for victims of shock.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. Orally STATE the most common cause of shock.
2. Orally DESCRIBE the symptoms of shock.
3. Orally EXPLAIN the procedures for treatment of victims of shock.

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LESSON TOPIC 3.4 FIRST AID TREATMENT

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
5 1/2 Hours	0 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course, he will be able to, given a hypothetical case requiring first aid treatment, describe, in a sequence of steps, appropriate action. Include, as a minimum, name of injury/conditions, treatment and post-treatment actions.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. Orally STATE the three purposes of first aid.
2. Orally DESCRIBE the conditions that necessitate the rescue of an injured person prior to the administration of first aid.
3. Orally STATE the general first aid rule.
4. DEFINE, in writing, terms used in first aid.
5. Wounds:
   a. Orally STATE the three basic rules in treating wounds.
   b. Orally DESCRIBE the principles involved in dressing wounds of the head, neck, chest, abdomen and limbs.
6. Fractures:
   a. EXPLAIN, in writing, how to immobilize the following types of fractures:
      (1) Simple
      (2) Compound
      (3) Greenstick
      (4) Comminuted
      (5) Impacted

LESSON TOPIC 3.4 (Continued)

ENABLING OBJECTIVES

6. b. DESCRIBE, in writing, the immobilization and transportation of a person with a fractured spine.

7. Heat Victims:

   a. Orally, DESCRIBE the treatment for heat exhaustion.
   b. Orally DESCRIBE the treatment for a victim suffering a heat stroke.

8. Burns:

   a. DESCRIBE, in writing, the three degrees of burns and how they are determined.
   b. DESCRIBE, in writing, the immediate first aid treatment for burn victims.

9. Cold Injuries:

   a. Orally DESCRIBE the categories of cold injuries.
   b. DESCRIBE, in writing, the treatment for various degrees of cold injuries.

10. Personnel Rescue:

   a. Orally, DESCRIBE each of the following stretchers and their uses:

      (1) Neil-Robertson
      (2) Stokes
      (3) Army Litter

   b. Orally, DESCRIBE the procedures to be followed to remove a victim of electrical shock in terms of your own safety.
   c. Orally, DESCRIBE the procedures to be followed to remove a victim overcome by toxic fumes in terms of your own safety.

11. Poisoned Wounds:

   a. DESCRIBE, in writing, the procedures for treatment of snake bite.

LESSON TOPIC 3.4 (Continued)

ENABLING OBJECTIVES

12. Animal Bites:

    a. Orally, DESCRIBE the major concern in all animal bites.
    b. DESCRIBE, in writing, the treatment for animal bites.

LESSON TOPIC 3.5 DIVING DISEASE/INJURY TREATMENT

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
20 Hours	1 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course he will be able to, given a hypothetical case involving a disease/injury/condition common to diving, describe, in a sequence of steps, appropriate action. Include, as a minimum, name of disease/injury/condition, selection proper treatment table, if appropriate, treatment and post-treatment actions. If treatment tables are necessary, make correct log entries.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. Circulatory and Respiratory System:

   a. LIST, in writing, the major organs in each system.
   b. Given an illustration of the systems, TRACE, a drop of blood and a molecule of air through the applicable system.
   c. Orally DESCRIBE the interface of the two systems and their importance to diving.
   d. DESCRIBE, in writing, the manner in which selected conditions hinder normal operation of the systems.

2. DESCRIBE, in writing, the symptoms, causes and proper methods of prevention/treatment for selected diver's diseases and injuries.

3. Treatment Tables:

   a. Orally, LIST the tables used in recompression treatments (except saturation).
   b. EXPLAIN, in writing, the application of selected equipment and devices used in recompression treatment.
   c. DEFINE, in writing, selected terms used in recompression treatment.

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LESSON TOPIC 3.5 (Continued)

ENABLING OBJECTIVES

3. d. Given selected conditions, DESCRIBE, in writing, the sequence of steps for treatment.
   e. EXPLAIN, orally, the need for recompression treatment and treatment tables.
   f. Orally, DESCRIBE the fundamentals involved in selecting the proper treatment tables.
   g. DESCRIBE, in writing, the symptoms of oxygen poisoning.
   h. DESCRIBE, in writing, the most frequent error related to treatment.
   i. Orally, DESCRIBE the fundamentals involved in recompression treatment in the water.
   j. DESCRIBE, in writing, the most vital features of hyperbaric chamber use.
   k. Orally, DESCRIBE the two basic types of treatment tables.
   l. DESCRIBE, in writing, the precautions that must be taken when transporting divers requiring decompression treatment.
   m. Orally, DESCRIBE the decompression on treatment tenders.
   n. EXPLAIN, in writing, the function(s) of components below in terms of what it does for the system; source of information required for its use; describe the components and explain the application or uses:

      (1) Treatment table for decompression sickness and air embolism.
      (2) Treatment table for minimal recompression O_2 breathing.

   o. For each treatment table component (section) DESCRIBE, orally, the physical location and application or use.
   p. Given the following, orally STATE the setpoint and reasons for the setpoint(s) in terms of the effects of operating above or below them.

      (1) Rate of ascent of each table.
      (2) Rate of descent for each table.
      (3) Time/depth limits for each table.

   q. Orally, DESCRIBE the effect on the treatment table system due to the Hyperbaric Chamber system.
   r. Orally, DESCRIBE the safety precautions unique to the treatment table system.

      (1) Accurate time and record keeping.

LESSON TOPIC 3.6 DANGEROUS MARINE LIFE

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
1 Hours	0 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course, he will be able to, given pictures/illustrations of marine life, identify with correct name, describe danger (if any) to divers, describe in a sequence of steps appropriate medical actions and precautions to avoid contact.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. For each of the following species, DESCRIBE, in writing, the physical characteristics, habitat and precautions to avoid contact, danger to divers (if any).

   a. Sharks
   b. Barracuda
   c. Groupers
   d. Moray Eels
   e. Killer whales
   f. Sea lions
   g. Barnacles and Mussels
   h. Giant clams
   i. Jelly fish
   j. Corals
   k. Octopus
   l. Cone shells
   m. Sea Urchins
   n. Stringrays
   o. Venomous fish
   p. Sea snakes

2. DESCRIBE, in writing, the procedures for treatment of snake bite, venomous fish stings, stingray wounds and jelly fish stings.

3. DESCRIBE, in writing, the treatment for bites from shark and barracuda.

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UNIT 4.0 OPEN CIRCUIT SCUBA DIVING

Contact Hours Allotted this Unit:

Classroom	Laboratory
15 Hours	49 Hours

TERMINAL OBJECTIVES:

Supported Entirely By This Unit:

1. When the student completes this course he will demonstrate, without error, all visual signals used while diving open circuit SCUBA.

2. When the student completes this course he will demonstrate proper inspection and maintenance procedures (in accordance with Planned Maintenance System Requirements) for the following open circuit SCUBA equipment and related underwater accessories: Open circuit SCUBA cylinder and manifold assembly, single hose regulator system, double hose regulator system, life jacket, diver's light and wet suit.

3. When the student completes this course he will demonstrate open circuit SCUBA charging procedures without error.

4. When the student completes this course he will, given a typical fleet SCUBA diving task, illustrate proper planning procedures by outlining steps necessary for a successful completion of the task.

5. When the student completes this course he will be able to demonstrate proficiency in the use of open circuit SCUBA equipment and complete Bureau of Naval Personnel SCUBA Diver (5345) qualification factors by:

   a. In open water, surface swim 1000 yards within twenty minutes using mask, fins and life jacket.
   b. In open water, swim 500 yards underwater with open circuit SCUBA as a member of a team, on a compass course, arriving at a designated point.
   c. In open water, swim to a depth of 130 feet using open circuit SCUBA.
   d. Demonstrate procedures for clearing open circuit SCUBA without error.

UNIT 4.0 (Continued)

TERMINAL OBJECTIVES

e. Demonstrate procedures for ditching and donning open circuit SCUBA, in accordance with the U.S. Navy Diving Manual.

f. In a Escape Training Tank, complete a positive buoyancy and a free ascent from a depth of at least 35 feet.

g. In open water, at night, using open circuit SCUBA, as a member of a two-man team, recover a specified object from a depth of at least 30 feet using a circling line, within thirty minutes.

h. As a member of a team, in open water, at night, using open circuit SCUBA, conduct a detailed underwater hull inspection of a designated craft. File a written report with the instructor which specifies propellors, shafting, rudders, sonar equipment, underwater fittings, and general hull conditions to include applicable measurements, marine growth and other specifics as instructed.

6. When the student completes this course he will be able to demonstrate a knowledge and understanding of safety precautions applicable to the open circuit SCUBA diving training activities.

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LESSON TOPIC 4.1 VISUAL SIGNALS

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
1/2 Hours	0 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course he will be able to demonstrate, without error, all visual signals used while diving open circuit SCUBA.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. LIST all visual signals used when diving open circuit SCUBA.

2. DEFINE, in writing, all visual signals used when diving open circuit SCUBA.

3. USE appropriate visual signals during open water diving training activities using open circuit SCUBA.

LESSON TOPIC 4.2 SCUBA INSPECTION AND MAINTENANCE PROJECT

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
8 Hours	6 Hours

TERMINAL OBJECTIVES

1. When the student completes this course he will demonstrate proper inspection and maintenance procedures (in accordance with Planned Maintenance System requirements) for the following open circuit SCUBA equipment and related underwater accessories: Open circuit SCUBA cylinder and manifold assembly, single hose regulator system, double hose regulator system, life jacket, diver's light and wet suit.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. Orally EXPLAIN the function(s) of each component and the component parts for each piece of equipment and underwater accessory.

2. Given a standard print of each component, SHOW the physical location of each component and component part.

3. LIST, in writing, the major materials used, EXPLAINING why, for each component and selected component parts.

4. LIST, orally, the protective device(s) found on the open circuit SCUBA cylinder and manifold assembly, single and double hose regulator, and life jacket and DESCRIBE the protection provided by each.

5. Orally LIST the position(s) and function(s) of each position for the Air Reserve Assembly and Block/Shut Off valve of the cylinder and manifold assembly system.

6. Orally DESCRIBE the nominal pipe or valve size for the elbow assembly and block/shut off valve.

7. Given a standard print of the components, DESCRIBE, orally, the flow path of the breathing media through the cylinder and manifold assembly and single/double hose regulator systems.

LESSON TOPIC: 4.2 (Continued)

ENABLING OBJECTIVES

8. For cylinder operating pressure, reserve air supply, safety discs and plugs, and over bottom pressure, STATE, orally, the major parameters and reasons for them, in terms of effect(s) of operating above/ below them.

9. Orally DESCRIBE the interrelation of the systems.

10. Orally DESCRIBE inspection/maintenance procedures for each component and component part within each piece of equipment.

11. PERFORM, under instructor guidance, inspection/ maintenance (in accordance with Planned Maintenance System requirements) on the equipment listed in the Terminal Objective so that it may be used in open circuit SCUBA diving training activities.

LESSON TOPIC 4.3 OPEN CIRCUIT SCUBA CHARGING

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
1 Hours	1/2 Hours

TERMINAL OBJECTIVES

1. When the student completes this course he will be able to demonstrate open circuit SCUBA charging procedures without error.

ENABLING OBJECTIVES

When the student completes this topic, he will be able to:

1. Orally DESCRIBE a typical diver's breathing air system by tracing it from the compressor/flask through the charging lines to the open circuit SCUBA cylinders.

2. Given a standard print of a typical diver's breathing air system, LABEL the physical location of the major components using the proper nomenclature.

3. Orally DESCRIBE the interrelation of Charles' Law with charging open circuit SCUBA.

4. Given an open circuit SCUBA charging checklist (for the available system) PREPARE, ACTIVATE and SECURE (after charging cylinders) the air supply delivery system.

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LESSON TOPIC 4.4 PLANNING

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
1 Hours	0 Hours

TERMINAL OBJECTIVES

1. When the student completes this course he will be able to, given a typical fleet SCUBA diving task, illustrate proper planning procedures by outlining steps necessary for a successful completion of the task.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. Orally STATE the main advantages/disadvantages of using open circuit SCUBA.

2. Orally DESCRIBE the application and/or use of open circuit SCUBA equipment.

3. DEFINE, orally and in writing, terms used in open circuit SCUBA diving.

4. Orally DISCUSS, with class members, procedures necessary for proper planning of the 130 foot qualification dive.

5. USE the pre-dive checklist contained in the U.S. Navy Diving Manual for planning the 130 foot qualification dive.

LESSON TOPIC 4.5 SURFACE SWIM

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
0 Hours	4 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course he will be able to, in open water, surface swim 1000 yards within twenty minutes using mask, fins and life jacket.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. In a swimming pool, demonstrate equipment confidence and proficiency by surface swimming twenty minutes with a mask, snorkel, fins, and a life jacket.

2. In open water, surface SWIM 1000 yards using a mask, fins and life jacket.

LESSON TOPIC 4.6 COMPASS SWIM

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
1 Hours	5 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course he will be able to, in open water, SWIM 500 yards underwater with open circuit SCUBA, as a member of a team, on a compass course, arriving at a designated point.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. DEMONSTRATE the setting and use of an underwater compass.

2. SWIM 500 yards underwater with open circuit SCUBA, as a member of a team, on a compass course, arriving at a designated area.

LESSON TOPIC 4.7 CLEARING, DITCHING & DONNING OPEN CIRCUIT SCUBA

Contact Hours Allotted This Lesson Topic

Classroom	Laboratory
0 Hours	17 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course he will be able to demonstrate procedures for clearing open circuit SCUBA without error.

2. When the student completes this course he will be able to demonstrate proper procedures for ditching and donning open circuit SCUBA, in accordance with the U.S.Navy Diving Manual.

3. When the student completes this course he will be able to, in open water, SWIM to a depth of 130 feet using open circuit SCUBA.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. In a swimming pool, first at a depth of four feet and then at a depth of at least nine feet, using open circuit SCUBA, DEMONSTRATE:

   a. The ability to breathe underwater.
   b. The top pressure face mask clearing procedure.
   c. The side pressure face mask clearing procedure.
   d. Single/double hose regulator clearing procedures.
   e. Buddy breathing.

2. At a swimming pool, first at poolside, then at a depth of four feet and finally at a depth of at least nine feet, using open circuit SCUBA, demonstrate ditching and donning procedures in accordance with the U.S.Navy Diving Manual.

3. In a swimming pool, at a depth of at least nine feet, using open circuit SCUBA, DEMONSTRATE the front step method of water entry.

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LESSON TOPIC: 4.7 (Continued)

ENABLING OBJECTIVES:

4. In a swimming pool, at a depth of at least nine feet, using open circuit SCUBA, DEMONSTRATE the ability to remain submerged under adverse conditions by properly responding to instructor imposed emergency situations (i.e. elimination of air supply, removal of equipment, etc.)

5. In open water, at a depth of at least twenty feet, using open circuit SCUBA, DEMONSTRATE:

   a. The ability to breathe underwater.
   b. The top pressure face mask clearing procedure.
   c. The side pressure face mask clearing procedure.
   d. Regulator clearing procedure.
   e. Buddy breathing.

6. In open water, at a depth of at least twenty feet, using open circuit SCUBA, DEMONSTRATE the front step method of water entry.

7. In open water, at a depth of at least twenty feet, using open circuit SCUBA, and proper tools, COMPLETE the Single Flange project in accordance with Diving Training Standards.

8. In open water, at a depth of at least twenty feet, as a member of a two-man team using open circuit SCUBA and proper tools, complete the Two-Man Flange project in accordance with Diving Training Standards.

LESSON TOPIC: 4.8 POSITIVE BUOYANCY AND FREE ASCENT TRAINING

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
0 Hours	2 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course he will have, in an Escape Training Tank, completed a positive buoyancy and a free ascent from a depth of at least 35 feet.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. Orally, EXPLAIN the application of positive buoyancy and free ascent training to an actual underwater condition/situation.

2. Orally DESCRIBE procedures, including safety precautions, involved in positive buoyancy and free ascent training.

3. In a swimming pool, at a depth of at least nine feet, after ditching open circuit SCUBA equipment, DEMONSTRATE positive buoyancy and free ascent procedures.

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LESSON TOPIC 4.9 NIGHT BOTTOM SEARCH

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
1 Hours	7 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course he will, in open water, at night, using open circuit SCUBA, as a member of a two-man team, recover a specified object from a depth of at least 30 feet using a circling line, within thirty minutes.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. Orally, DEFINE terms used in circling line, jack stay and surface tended methods of bottom searching using open circuit SCUBA.

2. Orally, EXPLAIN the usage of the circling line, jack stay and surface tended method of searching.

3. DEMONSTRATE procedures for assembling equipment and setting a circling line and jack stay for use in bottom searches.

4. Using circling line and jack stay techniques, CONDUCT searching exercises during daylight hours, recovering a specified object from the bottom.

5. USE proper surface tended searching procedures and signals during open circuit SCUBA training activities.

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LESSON TOPIC: 4.10 UNDERWATER HULL INSPECTION

Contact Hours Allotted This Lesson Topic

Classroom	Laboratory
2 Hours	5 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course he will be able to, as a member of a team, in open water, at night, using open circuit SCUBA, conduct a detailed underwater hull inspection of a designated craft. File a written report with the instructor which specifies propellors, shafting, rudders, sonar equipment, underwater fittings, and general hull conditions to include applicable measurements, marine growth and other specifics as instructed.

ENABLING OBJECTIVES

When the student completes this Lesson Topic, he will be able to:

1. Orally, EXPLAIN the function(s) of a detailed underwater hull inspection.

2. Given an illustration of a typical Navy submarine and surface vessel, LOCATE points included in a detailed underwater hull inspection, DESCRIBING measurements taken and conditions observed during such an inspection.

3. Given a description of a typical surface vessel hull, WRITE an inspection report using proper terminology, measurement data and organization.

4. In open water, in daylight, as a member of a team and using open circuit SCUBA, CONDUCT a detailed underwater hull inspection on an available craft. Provide a verbal report to the instructor.

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LESSON TOPIC: 4.11 GENERAL SAFETY PRECAUTIONS

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
1 Hours	2 1/2 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course he will be able to demonstrate a knowledge and understanding of safety precautions required in the use of open circuit SCUBA through the strict adherence to and usage of safety precautions applicable to the open circuit SCUBA diving training activities.

NOTE: Safety is an integral phase of all diving theory, systems and practical activity. It is difficult to separate items in order to enumerate specific safety precautions as Enabling Objectives for this Terminal Objective. Therefore, many important items of safety will be found in their respective sections concerning theory, systems and practical diving operations. The following safety items are those not specifically elaborated upon elsewhere.

ENABLING OBJECTIVES.

When the student completes this lesson topic, he will be able to:

1. Orally, STATE the most common and second most common diving accidents in the use of open circuit SCUBA.

2. Orally, DESCRIBE the minimum number of personnel required when diving open circuit SCUBA.

3. Orally, DESCRIBE normal and maximum working depth limitations for open circuit SCUBA.

4. Orally, DESCRIBE the reason for using the buddy system when diving open circuit SCUBA.

5. Orally, DESCRIBE the safety precautions to be followed when diving open circuit SCUBA:

   a. Planning the dive (use of checklist included).
   b. Dressing the diver.

LESSON TOPIC 4.11 (Continued)

ENABLING OBJECTIVES

c. During the dive (specific items not covered elsewhere).
d. Decompression (specific SCUBA application).
e. Charging SCUBA (mention specific safety items).
f. Reserve valve.

6. Orally, DESCRIBE the specific safety precautions involved in the following possible diving situations using open circuit SCUBA:

a. Diving on ships in a nest.
b. Diving using explosives.
c. Diving on a submarine hull.
d. During a propellor changes.
e. Diving in heavy currents.
f. Diving in extreme cold water.
g. Diving in polluted water.
h. Diving in enclosed spaces (specifically to elaborate upon the dangers of toxic gases).

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UNIT 5.0 DIVING ORIENTATION

Contact Hours Allotted this Unit:

Classroom	Laboratory
9 Hours	21 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Unit

1. When the student completes this course he will be able to, given an illustration of the MK V Deep Sea Diving System, label all major components correctly and explain the function(s) of each.

2. When the student completes this course he will be able to, as a diver, using the MK V Deep Sea Diving System in an open tank with a minimum of 8' of water:

   a. Demonstrate an ability to use the MK V Deep Sea Diving System in the underwater environment.
   b. Demonstrate all line-pull signals except those used in searching.

3. When the student completes this course, he will be able to, as a member of a team tending a diver using a MK V Deep Sea Diving System in an open tank:

   a. Demonstrate all tender-to-diver line-pull signals (except searching).
   b. Dress a diver in a MK V Deep Sea Diving System, within 15 minutes so that he may safely enter the water.
   c. Demonstrate proper telephone communication procedures and phraseology, in accordance with Diving Training Standards, under instructor guidance.
   d. Demonstrate proper inspection procedures for exhaust and non-return valves to insure safe operation.
   e. Demonstrate maintenance of the diving log(including OPNAV Form 9940-1) under instructor guidance.

LESSON TOPIC 5.1 MK V DEEP SEA DIVING SYSTEM

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
5 Hours	0 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course he will be able to, given an illustration of the MK V Deep Sea Diving System, label all major components correctly and explain the function of each.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. EXPLAIN, in writing, the function(s) of the major components of the MK V Deep Sea Diving System in terms of what they do for the system.

2. DESCRIBE, in writing, the functional and physical location of each of the major components of the MK V Deep Sea Diving System.

3. LIST, in writing, the protective devices for the major components of the MK V Deep Sea Diving System.

4. DESCRIBE, through illustration, the flow path of the breathing media through the MK V Deep Sea Diving System.

5. Orally, DESCRIBE the three types of surface supplied diving rigs.

6. Orally, EXPLAIN the application of the MK V Deep Sea Diving System.

7. STATE, in writing, the minimum number of personnel necessary to dive the MK V Deep Sea Diving System.

8. LIST, in writing, the advantages and disadvantages of the MK V Deep Sea Diving System.

9. STATE, orally, the maximum and working depths for the MK V Deep Sea Diving System.

10. STATE, in writing, the methods of communication used with the MK V Deep Sea Diving System.

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LESSON TOPIC 5.2 MK V DEEP SEA DIVING SYSTEM DIVER

Contact Hours Allotted this Lesson Topic:

Classroom	Laboratory
0 Hours	11 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course he will be able to, as a diver, using the MK V Deep Sea Diving System in an open tank with a minimum of eight feet of water:

   a. Demonstrate an ability to use the MK V Deep Sea Diving System in the underwater environment.
   b. Demonstrate all line-pull signals except those used in searching.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. DESCRIBE, orally, the application of equipment associated with the MK V Deep Sea Diving System.

2. Orally, DEFINE the terms ventilate and circulate.

3. Orally, STATE the safety precautions associated with the MK V Deep Sea Diving System.

4. LIST, in writing, all line-pull signals (except searching) and EXPLAIN the use of each signal.

5. Use the proper line-pull signals in all training dives.

6. In an open tank, at a depth of at least eight feet, using the MK V Deep Sea Diving System, PERFORM functions/actions comprising the MK V orientation dive (as described in Diving Training Standards) as directed by the instructor through the phone talker.

7. In an open tank, at a depth of at least eight feet, using the MK V Deep Sea Diving System, COMPLETE the Pipe Square Project in accordance with Diving Training Standards.

8. In an open tank, at a depth of at least eight feet, using the MK V Deep Sea Diving System, COMPLETE the Single Flange Project in accordance with Diving Training Standards.

LESSON TOPIC 5.3 MK V DEEP SEA DIVING SYSTEM TENDER

Contact Hours Allotted this Lesson Topic:

Classroom	Laboratory
2 Hours	11 Hours

TERMINAL OBJECTIVES

Supported Entirely by this Lesson Topic:

1. When the student completes this course, he will be able to, as a member of a team tending a diver using a MK V Deep Sea Diving System in an open tank:

   a. Demonstrate all tender-to-diver line-pull signals (except searching).
   b. Dress a diver in a MK V Deep Sea Diving System, within 15 minutes, so that he may safely enter the water.
   c. Demonstrate proper telephone communication procedures and phraseology, in accordance with Diving Training Standards, under instructor guidance.
   d. Demonstrate proper inspection procedures for exhaust and non-return valves to insure safe operation.
   e. Demonstrate maintenance of the diving log (including OPNAV Form 9940-1) under instructor guidance.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. LIST, in writing, all line-pull signals (except searching).

2. EXPLAIN, in writing, the use of all line-pull signals (except searching).

3. EXPLAIN, orally, proper phraseology of voice communication used when diving.

4. EXPLAIN, orally, proper operation of the diving telephone used for voice communication when diving.

5. Orally EXPLAIN, the proper procedures for dressing a diver in a MK V Deep Sea Diving System, so that he may safely enter the water.

6. As a member of a team, PRACTICE dressing a diver in a MK V Deep Sea Diving System.

LESSON TOPIC 5.3 (Continued)

ENABLING OBJECTIVES

7. Orally, EXPLAIN the inspection procedures for the exhaust and non-return valves on the MK V Deep Sea Diving System including the importance of the operation and frequency.

8. PRACTICE the operation of the telephone used in voice communication during diving operations. PRACTICE proper phraseology.

9. PRACTICE, under instructor guidance, inspecting the exhaust and non-return valves on the MK V Deep Sea Diving System.

10. Orally, EXPLAIN the reason for maintaining a log of diving operations (including OPNAV Form 9940-1).

11. Orally, EXPLAIN the procedures for completing the log containing information on diving activities (including OPNAV Form 9940-1).

12. PRACTICE, under instructor guidance, entering information in a typical diving log and OPNAV Form 9940-1.

UNIT 6.0 UNDERWATER BASIC

Contact Hours Allotted This Unit:

Classroom	Laboratory
8 Hours	22 Hours

TERMINAL OBJECTIVES:

Supported Entirely by This Unit:

1. When the student completes this course he will be able to, as a diver, using the MK V Deep Sea Diving System, in open water at a depth of at least twenty feet:

   a. Demonstrate all searching line-pull signals and proper response to tender's searching line-pull signals during the execution of the Searching Project in accordance with Diving Training Standards.
   b. Demonstrate a proficiency in the use of the MK V Deep Sea Diving System, by successfully completing, in accordance with Diving Training Standards, any two of the following projects: Single Flange, Seventeen Stud Pontoon, or Tooker Patch.
   c. Use proper voice and line-pull communications during all training dives.

2. When the student completes this course he will be able to, as a member of a team tending a diver, using a MK V Deep Sea Diving System in open water:

   a. Given directions by the topside supervisor (Instructor), guide the diver through the Searching Project (in accordance with Diving Training Standards) by using correct searching line-pull signals.
   b. Use correct telephone and line-pull communications procedures throughout all training dives.
   c. Dress a diver in a MK V Deep Sea Diving System, within twelve minutes, so that he may safely enter the water.
   d. Under instructor guidance, prepare the MK V Deep Sea Diving System for daily use and secure the gear upon completion of the daily diving activities.
   e. Demonstrate correct maintenance of the diving log (including OPNAV Form 9940-1) without error.

3. When the student completes this course, he will be able to, given a list of MK V Deep Sea Diving System component parts, demonstrate a knowledge of the function of each, by matching the component part with its functional description.

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LESSON TOPIC 6.1 MK V DEEP SEA DIVING SYSTEM

Contact Hours Allotted this Lesson Topic:

Classroom	Laboratory
5 Hours	0 Hours

TERMINAL OBJECTIVES

Supported Entirely by this Lesson Topic:

1. When the student completes this course he will be able to, given a list of MK V Deep Sea Diving System component parts, demonstrate a knowledge of the function of each, by matching the component part with its functional description.

ENABLING OBJECTIVES

When the student completes this Lesson Topic, he will be able to:

1. EXPLAIN, in writing, the function(s) of the component parts of the MK V Deep Sea Diving System in terms of what they do for the system.

2. DESCRIBE, by illustrating, the functional and physical location of the component parts within the major components.

3. EXPLAIN, in writing, how the component parts carry out their function(s).

4. Orally, DESCRIBE the major materials used to construct selected component parts and EXPLAIN why the particular material is used.

LESSON TOPIC 6.2 MK V DEEP SEA DIVING SYSTEM DIVER

Contact Hours Allotted this Lesson Topic:

Classroom	Laboratory
1 1/2 Hours	11 Hours

TERMINAL OBJECTIVES

Supported entirely by this Lesson Topic:

1. When the student completes this course he will be able to, as a diver using the MK V Deep Sea Diving System, in open water at a depth of at least twenty feet:

   a. Demonstrate all searching line-pull signals and proper response to tender's searching line-pull signals during the execution of the Searching Project in accordance with Diving Training Standards.
   b. Demonstrate a proficiency in the use of the MK V Deep Sea Diving System by successfully completing, in accordance with Diving Training Standards, any two of the following projects: Single Flange, Seventeen Stud Pontoon, or Tooker Patch.
   c. Use proper voice and line-pull communications during all training dives.

ENABLING OBJECTIVES

When the student completes this Lesson Topic, he will be able to:

1. LIST, in writing, all searching line-pull signals and EXPLAIN the use of each.

2. Using a short line between two persons, DEMONSTRATE all searching line-pull signals.

3. Using a short line between two persons, DEMONSTRATE the correct response (movement) to the tender's searching line-pull signals.

4. Orally EXPLAIN the Searching, Single Flange, Seventeen Stud Pontoon, and Tooker Patch Projects in accordance with Diving Training Standards.

5. Orally, DESCRIBE operation and communication procedures for use on the MK V Deep Sea Diving System Phone during normal operations (monitoring the dive, underwater cutting and welding and monitoring the Pneumo Fathometer).

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LESSON TOPIC 6.2 (Continued)

ENABLING OBJECTIVES

6. Orally, DESCRIBE operation and communication procedures for use on the MK V Deep Sea Diving System Phone during abnormal operations (i.e. loss of power, loss of communications, loss of gauge readings).

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LESSON TOPIC 6.3 MK V DEEP SEA DIVING SYSTEM TENDER

Contact Hours Allotted this Lesson Topic:

Classroom	Laboratory
1 1/2 Hours	11 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course, he will be able to, as a member of a team tending a diver using a MK V Deep Sea Diving System in open water:

   a. Given directions by the topside supervisor (instructor), guide the diver through the Searching Project (in accordance with Diving Training Standards) by using correct searching line-pull signals.
   b. Use correct telephone and line-pull communication procedures throughout all training dives.
   c. Dress a diver in a MK V Deep Sea Diving System, within twelve minutes, so that he may safely enter the water.
   d. Under instructor guidance, prepare the MK V Deep Sea Diving System for daily use and secure the gear upon completion of the daily diving activities.
   e. Demonstrate correct maintenance of the diving log (including OPNAV Form 9940-1) without error.

ENABLING OBJECTIVES

When the student completes this Lesson Topic, he will be able to:

1. LIST, in writing, all searching line-pull signals and EXPLAIN their use.

2. Using a short line between two persons DEMONSTRATE all searching line-pull signals.

3. DESCRIBE, orally, operation and communication procedures for the use of the MK V Deep Sea Diving System Phone during normal operations (monitoring the dive, underwater cutting and welding, and monitoring the Pneumo Fathometer).

4. DESCRIBE, orally, operation and communication procedures for use on the MK V Deep Sea Diving System Phone during abnormal operations (i.e. loss of power, loss of communications, loss of gauge readings).

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LESSON TOPIC 6.3 (Continued)

ENABLING OBJECTIVES

5. DESCRIBE, in writing, correct procedures for maintaining a diving log during normal/abnormal operations as described in 3 and 4 above.

6. Orally, EXPLAIN the function of the OPNAV Form 9940-1.

7. Orally, EXPLAIN the function of the Report Overlay and Report Form of the OPNAV Form 9940-1.

8. DESCRIBE, in writing, the proper completion of the OPNAV Form 9940-1, during normal operations, without error.

9. Orally, EXPLAIN the steps and equipment checkout involved in securing the MK V Deep Sea Diving System from daily use (Particular attention to cleaning and stowage).

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UNIT 7.0 UNDERWATER ADVANCED

Contact Hours Allotted This Unit:

Classroom	Laboratory
4 Hours	26 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Unit

1. When the student completes this course he will be able to, as a diver, using a MK V Deep Sea Diving System in open water at a depth of at least twenty feet, DEMONSTRATE increased proficiency in the use of the MK V Deep Sea Diving System by successfully completing, in accordance with Diving Training Standards, any three of the following projects: Angle Descent, Tunneling, Hogging Line, and Two Man Pontoon.

2. When the student completes this course he will be able to, as a member of a four man team, complete the applicable items of the Surface Supplied Diving Operations Pre-Dive Checklist to prepare the MK V Deep Sea Diving System for daily use and secure the gear upon completion of daily activities.

3. When the student completes this course he will be able to, as a member of a team tending a diver using a MK V Deep Sea Diving System:

   a. Use correct line-pull and telephone communication procedures throughout all training dives.
   b. Dress a diver in a MK V Deep Sea Diving System, within twelve minutes, so that he may safely enter the water.
   c. Demonstrate correct maintenance of the Diving Log and OPNAV Form 9940-1.

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LESSON TOPIC: 7.1 SURFACE SUPPLIED DIVING OPERATIONS
PRE-DIVE CHECKLIST

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
3 Hours	6 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course he will be able to, as a member of a four man team, complete the applicable items of the Surface Supplied Diving Operations Pre-Dive Checklist to prepare the MK V Deep Sea Diving System for daily use and secure the gear upon completion of the daily activities.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. Orally, EXPLAIN the use of the Surface Supplied Diving Operations Pre-Dive Checklist.

2. DEMONSTRATE the correct procedures for completing the items necessary for preparation of the MK V Deep Sea Diving System for daily use.

3. Using a standard print (illustration) of the school's diver's breathing air system:

   a. LABEL the print with correct symbols to show all major components.
   b. For the major components:

      (1) EXPLAIN, in writing, their function.
      (2) LIST, in writing, the protective devices within the system.
      (3) DESCRIBE, in writing, the protection provided by each device.
      (4) List, in writing, the ratings of applicable major components and materials used in their construction.

4. Orally, DESCRIBE the maximum standards for breathing air and the reasons for the standards.

5. Orally, STATE the setpoint(s) for cleaning, test and calibration of gauges.

LESSON TOPIC: 7.1 (Continued)

ENABLING OBJECTIVES

6. STATE, in writing, the safety precautions necessary to insure air purity.

7. DEMONSTRATE the correct procedures for completion of items necessary to secure the MK V Deep Sea Diving System from daily diving activities.

LESSON TOPIC: 7.2 MK V DEEP SEA DIVING SYSTEM DIVER

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
1 Hours	10 Hours

TERMINAL OBJECTIVES

Supported entirely by this Lesson Topic:

1. When the student completes this course he will be able to, as a diver, using a MK V Deep Sea Diving System in open water at a depth of at least twenty feet, DEMONSTRATE increased proficiency in the use of the MK V Deep Sea Diving System by successfully completing, in accordance with Diving Training Standards, any three of the following projects: Angle Descent, Tunneling, Hogging line, and Two Man Pontoon.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. Given a job analysis sheet on each project to be completed during this unit, orally EXPLAIN the following aspects of the project:

   a. What the project is.
   b. The conditions under which the project is to be completed.
   c. Standards which will determine success.
   d. How to perform the project successfully.
   e. How each project relates to a fleet diving job.
   f. Particular skills necessary for successful completion of the project.

NOTE: ORIGINAL PAGE 48 HAS BEEN DELETED; HOWEVER ALL MATERIAL IS INCLUDED.

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LESSON TOPIC: 7.3 MK V DEEP SEA DIVING SYSTEM TENDER

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
0 Hours	10 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course he will be able to, as a member of team tending a diver using a MK V Deep Sea Diving System:

   a. Use correct line-pull and telephone communication procedures throughout all training dives.
   b. Dress a diver in a MK V Deep Sea Diving System, within twelve minutes, so that he may safely enter the water.
   c. Demonstrate proper maintenance of the Diving Log and OPNAV Form 9940-1.

ENABLING OBJECTIVES

This is a continuation of skills and knowledge developed during other Terminal/Enabling Objectives.

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LESSON TOPIC: 8.0 LIGHT WEIGHT DIVING

Contact Hours Allotted This Unit:

Classroom	Laboratory
12 Hours	18 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course he will be able to, as a diver, perform the following functions:

   a. In an open tank, with a minimum of eight feet of water, using the Light Weight Diving System (Jack Browne), demonstrate ditching and donning procedures.
   b. In an open tank, with a minimum of eight feet of water, using the Mark I Mask, demonstrate emergency air change-over procedures.
   c. In open water, at a minimum depth of twenty feet, using the Mark I and Hot Water Suit, complete the Searching Project in accordance with Diving Training Standards.

2. When the student completes this course he will be able to, given Planned Maintenance System (PMS) requirements for the Light Weight Diving System, Mark I Mask, and Hot Water Suit, correctly perform the necessary maintenance.

3. When the student completes this course he will be able to, as a member of a team tending a diver in open water, using a Mark I Mask and Hot Water Suit Systems, demonstrate/explain start-up/shut-down procedures (as applicable) and operate the Clayton Diving Heater System (or other Navy approved locally available similar equipment.

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LESSON TOPIC 8.1 LIGHTWEIGHT DIVING SYSTEM DIVER

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
0 Hours	10 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course he will be able to, as a diver, perform the following functions:

   a. In an open tank, with a minimum of eight feet of water, using the Light Weight Diving System (Jack Browne), demonstrate ditching and donning procedures.
   b. In an open tank, with a minimum of eight feet of water, using the Mark I Mask, demonstrate emergency air change-over procedures.
   c. In open water, at a minimum depth of twenty feet, using the Mark I Mask and Hot Water Suit, complete the Searching Project in accordance with Diving Training Standards.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. Orally, EXPLAIN the correct procedures for dressing a diver using the Light Weight Diving System (Jack Browne).

2. Orally, DESCRIBE the prevailing conditions which would prompt a diver using the Light Weight Diving System to use the procedures of ditching and donning.

3. DEMONSTRATE correct procedures for ditching, clearing the mask, and donning for continued work, the Light Weight Diving System.

4. Orally, EXPLAIN the procedures for dressing a diver using the Mark I Mask.

5. DESCRIBE, orally, the prevailing conditions (including indications received by the diver) which would prompt a diver using the Mark I Mask to use the procedures for emergency air change-over.

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LESSON 8.1 (Continued)

ENABLING OBJECTIVES

6. DEMONSTRATE correct procedures for emergency air changeover, using the Mark I Mask.

7. Orally, EXPLAIN the correct procedures for dressing a diver in a Hot Water Suit.

8. DEMONSTRATE correct procedures for dressing a diver in a Hot Water Suit.

9. EXPLAIN, orally, the Searching Project, in accordance with Diving Training Standards, to include standards, how to perform the project, and particular skills needed for the successful completion of the project.

LESSON TOPIC 8.2 LIGHT WEIGHT DIVING SYSTEM

Contact Hours Allotted This Lesson Topic:

Classroom	Laboratory
6 Hours	2 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course, he will be able to, given the Planned Maintenance System (PMS) requirements for the Light Weight Diving System, Mark I Mask, and Hot Water Suit, correctly perform the necessary maintenance.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. Orally, EXPLAIN the maintenance requirements (periodic and usage) of the PMS.

2. Orally, EXPLAIN the documentation necessary for the PMS forms management.

3. For the Light Weight Diving System (Jack Browne).

   a. Orally, EXPLAIN the function(s) of the major components in terms of what they do for the system.
   b. Given a standard print (illustration) of the Light Weight Diving System, DESCRIBE, by labeling, the physical location of the major components and component parts.
   c. LIST, orally, the protective devices for the major components.
   d. LIST, in writing, the correct ratings of the umbilical.
   e. Orally, DESCRIBE the nominal valve size for the Air Control Valve.
   f. LIST, in writing, the major materials used in the major components and component parts and EXPLAIN why.
   g. EXPLAIN, orally, the function(s) of the component parts in terms of what they do for the components.
   h. Orally EXPLAIN how the component parts carry out their function(s).
   i. DESCRIBE, through illustration, the flow path of the breathing media through the system.

LESSON TOPIC 8.2 (Continued)

j. Orally STATE the setpoint(s) and reasons for the setpoint(s) in terms of the effects of operating above/below them as pertains to maximum depths and age of air hose in using the Light Weight Diving System.
k. Orally, DESCRIBE the effect of the Light Weight Diving System due to the breathing media source.
l. Orally, DESCRIBE the correct installation of the non-return valve on to the air control valve.

4. For the Mark I Mask:

a. Orally, EXPLAIN the function(s) of the major components in terms of what they do for the system.
b. Given a standard print of the MK I Mask, DESCRIBE by labeling, the physical location of the major components and their component parts.
c. Orally, DESCRIBE the sources of power for communications used with the MK I Mask System.
d. DEMONSTRATE and orally DESCRIBE the modes of control for the side valve and second state dial-a-breath.
e. LIST, in writing, the ratings for the umbilical and emergency bottle assembly.
f. DESCRIBE, in writing, the major materials used, EXPLAINING why, for the major components and their component parts.
g. Orally EXPLAIN the function(s) of the component parts in terms of what they do for the components.
h. EXPLAIN, orally, how the component parts carry out their function(s).
i. DEMONSTRATE and orally DESCRIBE the modes of operation and the flow path of the breathing media through the MK I Mask in each mode.
j. STATE, in writing, the maximum depth without come home bottle, without open bell, and diving on air using the MK I Mask, and the reasons for these maximums.
k. Orally DESCRIBE the effect on this MK I Mask System due to the umbilical, emergency bottle assembly, diver heating system, open diving bell system and breathing media source.
l. EXPLAIN, orally, the unique safety precautions of using only 120 VAC for recharging battery if amplifier is equipped with a rechargeable battery.

LESSON TOPIC 8.2 (Continued)

5. For the Hot Water Suit:

   a. Orally EXPLAIN the function(s) of the major components in terms of what they do for the system.
   b. Given a standard print of the Hot Water Suit, DESCRIBE, by labeling, the physical location of the major components and their component parts.
   c. DEMONSTRATE the operation of the velco strips.
   d. LIST, in writing, the rating(s) of the tubing within the Hot Water Suit.
   e. LIST, in writing, the major materials used in the major components and their component parts and EXPLAIN why.
   f. Orally EXPLAIN their function(s) of the component parts in terms of what they do for the components.
   g. Orally EXPLAIN how the component parts carry out their function(s).
   h. DEMONSTRATE how and where the control function is accomplished.
   i. Orally, DESCRIBE the effect on the Hot Water Suit due to the Clayton Diving Heater System and the MK I Mask System.

6. For the Open Diving Bell:

   a. Orally, EXPLAIN the function(s) of the major components and their component parts.
   b. Given an illustration of a typical open diving bell, LOCATE, by labeling, the major components.
   c. EXPLAIN, in writing, how the major components carry out their function(s).
   d. LIST, in writing, the major materials used in constructing and open diving bell and EXPLAIN why.
   e. Orally DESCRIBE the flow path of the breathing media through the system and the pressurization of the hull body.
   f. Orally EXPLAIN the safety aspects of maintaining the bell in an upright position during operation.

LESSON TOPIC 8.3 CLAYTON DIVING HEATER SYSTEM

Contact Hours Allotted this Lesson Topic:

Classroom	Laboratory
4 Hours	8 Hours

TERMINAL OBJECTIVES

Supported Entirely By This Lesson Topic:

1. When the student completes this course, he will be able to, as a member of a team tending a diver in open water, using MK I Mask and Hot Water Suit Systems, demonstrate/explain startup/shutdown procedures (as applicable) and operate the Clayton Diving Heater System (or other Navy approved locally available similar equipment).

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. For the Clayton Diving Heater System:

   a. Orally EXPLAIN the function(s) of the major components and component parts in terms of what they do for the system.
   b. Given a standard print of the Clayton Diving Heater System, DESCRIBE, by labeling, the physical location of the major components and their component parts.
   c. Describe by illustration, the sources of power for the major components.
   d. Describe, orally, the protection provided and the ratings of each of the major components.
   e. Orally EXPLAIN how the component parts carry out their function(s).
   f. DESCRIBE, in writing, the major materials used in the component parts and explain why.
   g. DESCRIBE, by illustration, the flow path of sea water through the sea water supply system.
   h. DESCRIBE, by illustration, the flow path of steam from the auxiliary steam inlet to the auxiliary outlet.
   i. DESCRIBE, by illustration, the flow path of fresh water through the fresh water and steam systems.
   j. DESCRIBE, by illustration, the fuel flow through the fuel system to the burner.

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LESSON TOPIC 8.3 (Continued)

k. Orally DESCRIBE lighting off/securing procedures.
l. DESCRIBE, by illustration, the location at which the following is monitored: operating steam pressure, maximum temperature to the diver, and seawater inlet pressure and flow.
m. Orally DESCRIBE the effect on this system due to a ship's auxiliary steam/condensate system, fire main system and electrical source.
n. Orally DESCRIBE the effect on the Diver's Hot Water Suit due to the operation of the Clayton Diving Heating System.

UNIT 9.0 UNDERWATER TOOLS

Contact Hours Allotted this Unit:

Classroom	Laboratory
4 Hours	26 Hours

TERMINAL OBJECTIVES

Supported Entirely by this Unit:

1. When the student completes this course, he will be able to, in an open tank, with at least eight feet of water, using the MK I Mask System and appropriate underwater tools, complete the following projects in accordance with Diving Training Standards: Three Hole Flange, Drill and Tap, and Underwater Piling Saw (Hydraulic).

NOTE: ORIGINAL PAGE 58 HAS BEEN DELETED; HOWEVER ALL MATERIAL IS INCLUDED.

LESSON TOPIC 9.1 UNDERWATER TOOLS

Contact Hours Allotted this Lesson Topic:

Classroom	Laboratory
4 Hours	26 Hours

TERMINAL OBJECTIVES

Supported entirely by this Lesson Topic:

1. When the student completes this course, he will be able to, in an open tank, with at least eight feet of water, using the MK I Mask and appropriate underwater tools, complete the following projects in accordance with Diving Training Standards: Three Hole Flange, Drill and Tap, and Underwater Piling Saw (Hydraulic).

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. Orally DEFINE/EXPLAIN terms relative to the use of underwater tools.

2. Orally DESCRIBE a surface supplied hydraulic set-up and the basic operation of selected underwater tools.

3. Orally DESCRIBE how the underwater tools work with selected attachments.

4. Orally DESCRIBE the special insulating and safety requirements for underwater electric tools and lights.

5. Orally DESCRIBE loading and firing procedures and techniques for using the velocity power driver.

6. For the velocity power driver, pneumohydraulic grinder and drill:

   a. Orally EXPLAIN the function(s) of each tool in terms of what they do for the system.
   b. DESCRIBE, in writing, the source(s) of power.
   c. Orally DESCRIBE the modes of control.
   d. Orally LIST the protective devices and ratings for each tool.

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LESSON TOPIC 9.1 (Continued)

7. Given a job analysis sheet on each project to be completed during this unit, orally EXPLAIN the following aspects of the project:

   a. What the project is.
   b. Conditions under which the project is to be completed.
   c. Standards which will determine success.
   d. How to perform the project successfully.
   e. How each project relates to a fleet diving job.
   f. Particular skills necessary for the successful completion of the project.

UNIT 10.0 UNDERWATER CUTTING AND WELDING

Contact Hours Allotted This Unit:

Classroom	Laboratory
6 Hours	24 Hours

TERMINAL OBJECTIVES

Supported Entirely by this Unit:

1. When the student completes this course, he will be able to, in an open tank with at least eight feet of water, using the MK V Deep Sea Diving System, successfully complete any three of the following projects in accordance with Diving Training Standards: Oxygen Arc Cutting (Ceramic Rod), Oxygen Arc Cutting (Steel Tubular Rod), Shielded Metal Arc Cutting, and Shielded Metal Arc Welding.

NOTE: ORIGINAL PAGE 61 HAS BEEN DELETED; HOWEVER, ALL MATERIAL HAS BEEN INCLUDED.

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LESSON TOPIC 10.1 UNDERWATER CUTTING AND WELDING

Contact Hours Allotted this Lesson Topic:

Classroom	Laboratory
6 Hours	24 Hours

TERMINAL OBJECTIVES

Supported Entirely by this Lesson Topic:

1. When the student completes this course, he will be able to, in an open tank with at least eight feet of water, using the MK V Deep Sea Diving System, successfully complete any three of the following projects in accordance with Diving Training Standards: Oxygen Arc Cutting (Ceramic Rod), Oxygen Arc Cutting (Steel Tubular Rod), Shielded Metal Arc Cutting, Shielded Metal Arc Welding.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. DEFINE/EXPLAIN, in writing, terms relative to underwater cutting and welding.

2. Orally DESCRIBE the types of cutting and welding that will be used in completion of the projects during this unit.

3. DESCRIBE, in writing, the various materials used in underwater cutting and welding.

4. Orally EXPLAIN the function(s) of the various methods of underwater cutting and welding used in completion of the projects for this unit.

5. For each of the types of underwater cutting and welding used in completion of the projects during this unit:

   a. EXPLAIN, in writing, the function(s) of the component parts in terms of what they do for the individual components.
   b. DESCRIBE, by illustration, the physical location of the component parts within each of the major components.
   c. Orally EXPLAIN how the component parts carry out their function(s).

LESSON TOPIC 10.1 (Continued)

d. LIST, in writing, the ratings and specifications of selected component parts.
e. DESCRIBE, by illustration, the source(s) of power for selected component parts.
f. Orally DESCRIBE the protection provided the system by applicable component parts.
g. DESCRIBE, in writing, the major materials used in construction of selected component parts, and EXPLAIN why the particular materials are used.

6. DESCRIBE, in writing, the important features of each of the various cutting processes used to complete the projects of this unit.

7. Orally DESCRIBE the procedure for determining the polarity of a welding generator if polarity markings are illegible.

8. Orally EXPLAIN a simple schematic diagram of a typical arrangement for oxygen arc cutting.

9. DESCRIBE, in writing, the advantages of steel tubular electrodes versus the advantages of ceramic tubular electrodes.

10. Orally EXPLAIN the preparation of an emergency tubular electrode.

11. Orally DESCRIBE cutting techniques for oxygen arc for thick and thin steel plate using the steel tubular and ceramic tubular electrodes.

12. DESCRIBE, in writing, the principle of operation for shielded metal arc cutting.

13. DESCRIBE, in writing, the proper metallic arc cutting technique for steel plate less than 1/4 inch thick and for plates greater than 1/4 inch thick.

14. EXPLAIN, in writing, the advantages of oxygen hydrogen cutting.

15. Orally EXPLAIN why hydrogen and not acetylene is used as a fuel gas.

16. DESCRIBE, in writing, the principle of operation in oxygen hydrogen cutting.

LESSON TOPIC 10.1 (Continued)

17. EXPLAIN, orally and in writing, procedures for lighting the oxygen hydrogen torch underwater.

18. EXPLAIN, orally and in writing, the techniques for starting and advancing the cut with an oxygen hydrogen torch.

19. DESCRIBE, in writing, the principle of operation for shielded metal arc welding.

20. DESCRIBE, in writing, the largest diameter electrode recommended for shielded metal arc welding operations.

21. DESCRIBE and DEMONSTRATE the preparation of an underwater surface for welding.

22. DESCRIBE, orally and in writing, the importance of the welding current setting.

23. STATE, in writing, the setpoint(s) and reasons for the setpoint(s) in terms of operating above or below them,for:

    a. Figuring correct gas pressure at depth.
    b. Polarity.

24. DESCRIBE, in writing, and DEMONSTRATE safety precautions unique to underwater cutting and welding.

    a. Trapped explosive gases.
    b. Placing the diver between the ground and electrode.

25. Given a job analysis sheet for each project to be completed during this unit, orally EXPLAIN the following aspects of the project:

    a. What the project is.
    b. The conditions under which the project will be completed.
    c. Standards which will determine success.
    d. How to perform the project successfully.
    e. How each project relates to a fleet diving job.
    f. Particular skills necessary for the successful completion of the project.

26. In an open tank with at least eight feet of water, using the MK V Deep Sea Diving Systems, PRACTICE each of the underwater cutting methods used in completion of the projects for this unit. As many as three electrodes (one ceramic) may be used for practice(determined by the student).

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UNIT 11.0 DIVING EQUIPMENT REPAIR

Contact Hours Allotted this Unit:

Classroom	Laboratory
6 Hours	24 Hours

TERMINAL OBJECTIVES

Supported Entirely by this Unit:

1. When the student completes this course, he will be able to, given a MK V Deep Sea Diving System Helmet, perform the following maintenance so that the equipment may be used in diving operations: Replace port glass, replace breast plate gasket, and replace breast plate stud. Additional maintenance items are to be accomplished dependent upon time and equipment requirements.

2. When the student completes this course, he will be able to, given a MK V Deep Sea Diving System Dress, perform the following maintenance so that the equipment may be used in diving operations: Placing/replacing gloves, patching a hole, air test dress before/after patching. Additional maintenance items are to be accomplished dependent upon time and equipment requirements.

3. When the student completes this course, he will be able to, given components of the MK V Deep Sea Diving System Umbilical, perform the following maintenance so that the equipment may be used in diving activities: Marry life line/air hose, and repair or replace jack plug on life line, telephone cable. Additional maintenance items are to be accomplished dependent upon time and equipment requirements.

4. When the student completes this course, he will be able to, given a MK V Deep Sea Diving System Non-Return valve, perform the following maintenance so that the equipment may be used in diving operations: Replace the stem and seat, replace the spring and gasket.

5. When the student completes this course, he will be able to, given a MK V Deep Sea Diving System air control valve, perform the following maintenance so that the equipment may be used in diving operations: Lap in the needle valve, renew flax packing in packing gland, and adjust packing gland.

LESSON TOPIC 11.1 MK V DEEP SEA DIVING SYSTEM HELMET

Contact Hours Allotted this Lesson Topic:

Classroom	Laboratory
2 Hours	5 Hours

TERMINAL OBJECTIVES

Supported Entirely By this Lesson Topic:

1. When the student completes this course, he will be able to, given a MK V Deep Sea Diving System Helmet, perform the following maintenance so that the equipment may be used in diving operations: Replace port glass, replace breast plate gasket, and replace breast plate stud. Additional maintenance items are to be accomplished dependent upon time and equipment requirements.

    a. Replace breast plate padeye.
    b. Replace telephone jack in gooseneck.
    c. Replace reproducer.
    d. Chase threads on the Air Gooseneck, Telephone Gooseneck and breast plate studs.
    e. Replace safety locking device.
    f. Replace or lap in the supplementary exhaust valve.
    g. Lap in and adjust the exhaust valve.
    h. Replace face plate and gasket.
    i. Test communications.
    j. Make new lanyards for the breast plate eyelets and install them.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. For each of the repairs/maintenance requirements listed above:

    a. Orally STATE the common cause(s) of the equipment damage/failure/leak which would lead to repairing or replacing the specific piece of equipment.
    b. LIST, in writing, the tools needed for the specific repair.
    c. EXPLAIN, in writing, step-by-step procedures for effecting the repair or replacement.
    d. Orally EXPLAIN the importance of doing proper repairs - including results if repair procedures are not carried out properly.

LESSON TOPIC 11.2 MARK V DEEP SEA DIVING SYSTEM DRESS

Contact Hours Allotted this Lesson Topic:

Classroom	Laboratory
2 Hours	5 Hours

TERMINAL OBJECTIVES

Supported Entirely by this Lesson Topic:

1. When the student completes this course, he will be able to, given a MK V Deep Sea Diving System Dress, perform the following maintenance so that the equipment may be used in diving operations: Placing/replacing gloves, patching a hole, air test dress before/after patching. Additional maintenance items are to be accomplished dependent upon time and equipment requirements.

   a. Replacing lacing flap.
   b. Replace crotch patch.
   c. Repair and patch torn rubber gasket on collar.
   d. Renew lead weights on MK V Deep Sea Diving System weight belt.
   e. Renew straps and buckles on MK V Deep Sea Diving System shoes.
   f. Clean and preserve MK V Deep Sea Diving shoe leather.
   g. Renew grommets on Mark V Deep Sea Diving System shoes.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. For each of the repairs/maintenance requirements listed above:

   a. Orally STATE the common cause(s) of the equipment damage/failure/leak which would lead to repairing or replacing the specific piece of equipment.
   b. LIST, in writing, the tools needed for the specific repair.
   c. EXPLAIN, in writing, step-by-step procedures for effecting the repair or replacement.
   d. Orally EXPLAIN the importance of doing proper maintenance to include results if repair procedures are not carried out properly.

LESSON TOPIC 11.3 MARK V DEEP SEA DIVING SYSTEM UMBILICAL

Contact Hours allotted this Lesson Topic:

Classroom	Laboratory
1 Hours	4 Hours-

TERMINAL OBJECTIVES

Supported Entirely by this Lesson Topic:

1. When the student completes this course, he will be able to, given components of the MK V Deep Sea Diving System umbilical, perform the following maintenance so that the equipment may be used in diving activities: Marry life line/air hose, and repair or replace jack plug on life line, telephone cable. Additional maintenance items are to be accomplished dependent upon time and equipment requirements.

   a. Insert fitting in light weight hose.
   b. Place/replace boot.
   c. Paint boot.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. For each of the repairs/maintenance requirements listed above:

   a. Orally STATE the common cause(s) of the equipment damage/failure/leak which would lead to repairing or replacing the specific piece of equipment.
   b. LIST, in writing, the tools needed for the specific repair.
   c. EXPLAIN, in writing, step-by-step procedures for effecting the repair or replacement.
   d. Orally EXPLAIN the importance of doing proper maintenance to include results if repair procedures are not carried out properly.

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LESSON TOPIC 11.4 MK V DEEP SEA DIVING SYSTEM NON-RETURN VALVE

Contact Hours Allotted this Lesson Topic:

Classroom	Laboratory
1/2 Hours	5 Hours

TERMINAL OBJECTIVE

Supported Entirely by this Lesson Topic:

1. When the student completes this course, he will be able to, given a MK V Deep Sea Diving System non-return valve, perform the following maintenance so that the equipment may be used in diving operations: Replace the stem and seat, and replace the spring and gasket.

ENABLING OBJECTIVES

When the student completes this lesson topic he will be able to:

1. For each of the repairs/maintenance requirements listed above:

   a. Orally STATE the common cause(s) of the equipment damage failure/leak which would lead to repair/replacement of the specific piece of equipment.
   b. LIST, in writing, the tools needed for the specific repair.
   c. EXPLAIN, in writing, step-by-step procedures for effecting the repair or replacement.
   d. Orally EXPLAIN the importance of doing proper maintenance to include results if procedures are not carried out properly.

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LESSON TOPIC 11.5 MARK V DEEP SEA DIVING SYSTEM AIR CONTROL VALVE

Contact Hours Allotted this Lesson Topic:

Classroom	Laboratory
1/2 Hours	5 Hours

TERMINAL OBJECTIVES

Supported Entirely by this Lesson Topic:

1. When the student completes this course, he will be able to, given a MK V Deep Sea Diving System air control valve, perform the following maintenance so that the equipment may be used in diving operations: Lap in needle valve, renew flax packing in packing gland and adjust packing gland.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. For each of the repairs/maintenance requirements listed above:

   a. Orally STATE the common cause(s) of the equipment damage/failure/leak which would lead to repair/ replacement of the specific piece of equipment.
   b. LIST, in writing, the tools needed for the specific repair.
   c. EXPLAIN, in writing, step-by-step procedures for effecting the repair or replacement.
   d. Orally EXPLAIN the importance of doing proper maintenance to include results if procedures are not carried out properly.

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UNIT 12.0 HYPERBARIC CHAMBER

Contact Hours Allotted this Unit:

Classroom	Laboratory
6 Hours	24 Hours

TERMINAL OBJECTIVES

Supported Entirely by this Unit:

1. When the student completes this course, he will be able to, given hypothetical diving accidents requiring treatment in the Hyperbaric Chamber, perform the functions of an outside Hyperbaric Chamber Operator under the guidance of a Diving Supervisor.

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LESSON TOPIC 12.1 HYPERBARIC CHAMBER

Contact Hours Allotted this Lesson Topic:

Classroom	Laboratory
6 Hours	24 Hours

TERMINAL OBJECTIVES

Supported Entirely by this Lesson Topic:

1. When the student completes this course, he will be able to, given hypothetical diving accidents requiring treatment in the Hyperbaric Chamber, perform the functions of an outside Hyperbaric Chamber Operator under the guidance of a Diving Supervisor.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

1. Given a standard print of the Hyperbaric Chamber System:

   a. EXPLAIN, in writing, the function(s) of the major components in terms of what they do for the system.
   b. DESCRIBE/SHOW, by labeling, the physical location of the major components and their component parts.
   c. DESCRIBE, in writing, the sources of power for the supply piping arrangement and communication components.
   d. Orally DESCRIBE the modes of control.
   e. List, in writing,the protective devices for the major components.
   f. LIST, orally, the ratings of the major components.
   g. DESCRIBE, in writing, the nominal pipe or valve size used throughout the Hyperbaric Chamber System.
   h. LIST, in writing, the major materials used in the major components and their component parts, and EXPLAIN why.
   i. Orally EXPLAIN how the components and component parts carry out their function(s).
   j. DESCRIBE, in writing, procedures for pressurization and depressurization of the recompression chamber,
   k. DESCRIBE, in writing, the administration of HeO2/ O2 to the recompression chamber.
   l. DESCRIBE, in writing, procedures for ventilation of the recompression chamber.

LESSON TOPIC 12.1 (Continued)

ENABLING OBJECTIVES

m. Orally STATE the setpoint(s) and reasons for the setpoint(s) in terms of operating above or below them, for:

(1) The maximum working pressure of the chamber.
(2) Ventilation rate, O_2, air.

n. DESCRIBE, in writing, the effect on this system due to the air and electrical sources.

o. Orally EXPLAIN the safety precautions unique to the operation of the Hyperbaric Chamber, to include the following.

(1) Use of fire retardant material inside the chamber.
(2) Release of dogs prior to depressurization of the chamber.

2. Under the guidance of the instructor, DEMONSTRATE procedures for pressurization of the chamber, checking for leaks, and normal operation of gauges.

3. LIST situations common to diving, in writing, where the Hyperbaric Chamber would be required for medical treatment.

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ANNEX I - EQUIPMENT

TYPE DESIGNATOR	NOMENCLATURE	FEDERAL STOCK NUMBER	QNTY REQ	PER ITEM COST
	Deep-Sea Diving outfit, Air			
	Sufficient quantities of the below listed components to establish and maintain two working and one standby diver.			
	Amplifier	N-5830-184-1787		$1,120.00
	Belt, Weight	H-4220-223-6670		212.00
	Cable, combination amplifier & lifeline			
	200 feet	G-5995-184-0096		669.00
	600 feet	G-5995-240-3225		1,487.00
	Clamps, airhose	C-4730-289-5912		.27
	Coupling, airhose			
	Female	C-4730-369-4589		5.94
	Male	C-4730-224-7325		10.10
	Coupling, diving cable, telephone			
	New Style	5935-188-5844		3.70
	Cuffs, Diver's Dress	H-4220-223-6667		4.80
	Cushion, Diver's Helmet	H-4220-223-6659		4.22
	Dress, Diving			
	Size #1, small	H-4220-223-6660		220.00
	Size #2, medium	H-4220-223-6661		195.00
	Size #3, large	H-4220-223-6662		200.00
	Faceplate, clear	H-4220-351-2295		63.00
	Faceplate, welding	H-4220-351-2296		44.50
	Gasket, faceplate	Z-5220-197-8423		.13
	Gasket, helmet, leather	C-4220-194-4834		4.20
	Glass, helmet, side window	H-4220-355-5459		2.45
	Glass, helmet, top window	H-4220-355-5458		2.39
	Glove, diver's			
	Left Hand	C-4220-640-1529		38.00
	Right Hand	H-4220-640-1530		79.00
	Gloves, woolen, pr	D-8415-682-6575		1.24
	Hose, assembly, air	MIL-H-2815		
	High Pressure			
	3 feet	C-4220-230-6531		64.00
	50 feet	C-4220-230-6533		139.00
	200 feet (as available)	SAME MILSPEC		

ANNEX I - EQUIPMENT

TYPE DESIGNATOR	NOMENCLATURE	FEDERAL STOCK NUMBER	QNTY REQ	PER ITEM COST
Deep-Sea Diving outfit, Air (cont'd)				
	Helmet, deep sea diver, No. 1	C-4220-223-6605		$ 695.00
	Jackbox, amplifier coilspring(new style)	N-5935-243-5974		21.00
	flatspring(old style)	N-5935-184-1790		23.00
	Lens, welding faceplate			
	No. 4	H-4220-369-4538		2.22
	No. 6	H-4220-369-4539		4.30
	No. 8	H-4220-369-4540		1.10
	Manifold, air	C-4220-142-1073		207.00
	Nut,wing,breastplate			
	large	H-5310-388-3438		.32
	small	Z-5310-388-3439		.27
	Safety latch,helmet	H-4220-355-5461		1.10
	Shoes, diver's			
	light (26 lbs)	C-4220-278-9954		82.00
	heavy (40 lbs)	C-4220-223-6669		235.00
	Springs,primary $ secondary regulating			
	escape valve	H-4220-270-3087		3.00
	Strap, cuff,divers			
	dress with buckle	H-4220-371-8068		1.58
	Stud, breastplate			
	long	H-4220-351-9152		.11
	short	H-4220-351-9153		.48
	Trousers,overalls	C-4220-223-6666		15.70
	Valve,air control			
	angle	C-4220-265-6953		57.50
	Valve,regulating air			
	escape (exhaust)	C-4220-371-8070		44.70
	Valve,air,non-return			
	new	C-4220-419-4806		48.00
	Washer,copper,for			
	breastplate straps	Z-5310-194-7252		.04
	Washer,airhose	H-4220-250-2130		.13
	Washer,non-return			
	valve seat	Z-5330-239-1858		.07
	Washer,amplifier	Z-5330-033-6613		.20

TYPE DESIGNATOR	NOMENCLATURE	FEDERAL STOCK NUMBER	QNTY REQ	PER ITEM COST
Diving Outfit, Lightweight (A Set, FSN 1 H-4220-300-9929)				
Sufficient quantities of the below listed components to establish and maintain two working and one standby diver.				
	Belt,leather	C-4220-223-6671		$ 149.00
	Dress, swimmers wet suit	Open Purchase		
	Gloves,divers			
	left hand	C-4220-640-1529		38.00
	right hand	H-4220-640-1530		79.00
	Gloves,woolen,pr	D-8415-682-6575		1.24
	Harness,head,mask	H-4220-369-4535		3.50
	Hose,assembly 300ft.	C-4720-293-7997		26.00
	Knife and sheath divers	C-4220-372-0665		80.00
	Mask,divers	C-4220-223-6665		96.00
	Shoes,divers,light (26 lbs)	C-4220-278-9954		82.00
	Trousers,divers	H-4220-223-6666		15.70
	Tubing, elastic	G-4720-221-2454		6.50
	Valve,control,globe	H-4220-369-4547		2.20
	Valve,flapper,mask	H-4220-369-4549		.84
	Valve,non-return	C-4220-383-3825		11.80
	Mk I KMB-9 Mask	Open Purchase		
	Hot Water Suit	Open Purchase		
	Hot Water Hose	Open Purchase		
	Airhose/Communications Line,KMT-9	Open Purchase		
	Helle Phone	Open Purchase		
	Clayton Hot Water Boiler	Open Purchase		
	Box 12 Studs	*		33.00
	Stud Gun WOX-1 Mine Safety Appliance CNTR.	*		1,800.00
	Hydraulic Tool Package	*		**15,000.00-- 25,000.00

ANNEX I - EQUIPMENT

TYPE DESIGNATOR	NOMENCLATURE	FEDERAL STOCK NUMBER	QNTY REQ	PER ITEM COST
SCUBA Diving, Open Circuit				
*	Wet Suits (comp.)		16	
*	SCUBA Face Mask		16	
*	SCUBA Swim Fins,pr		16	
*	Life Vest	2H 4200-051-3078	16	$ 143.00
	Knife		16	
	Compass	1H 6605-079-0007	8	105.00
	Depth Gauge	2H 4220-639-8999	8	343.00
*	Snorkel		16	
*	SCUBA Cylinders, 71.2 Steel,pr		16	
*	Single Hose Regulator		16	
	CO2 Cartridge	9C 4220-965-0595	16	6.25
*	Buoy and Line		8	
*	Buddy Line, 10'		8	
	Strobe Light	9G 6230-067-5209	16	18.10
	Strobe Light Batteries	9A 6135-073-8939	16	1.94
	Workboat	1095-764-1585	1	30,000.00
*	Inflatable Safety Boat		1	
*	Outboard Motor, 25hp		1	
*	Jackstay Searching Rig		1	
*	Slate, Underwater		16	
*	Calipers		2	
*	Circling Line Searching Rig		1	
	Recompression Chamber	S-4220-540-2785	1	8,000.00
	Stopwatch	6645-00-126--0286	2	68.00

ANNEX I - EQUIPMENT

TYPE DESIGNATOR	NOMENCLATURE	FEDERAL STOCK NUMBER	QNTY REQ	PER ITEM COST
Cutting and Welding Equipment				
*	D-C Generator, Welding 300 amp Capacity		1	
*	Knife Switch, Type K Infusible, Single Pole, Single Throw 200 amp, 250 volts.		1	
	Welding Cable, Size 2/0	9G-5995-184-0096	as req	669.00
*	Welding Cable size 1/0		as req	
	Type TRXF, 10ft	3433-372-0655	1	101.00
*	Male Connector		as req	
*	Female Connector		as req	
	Grounding Clamp	9Q-5120-180-0908	1	3.76
*	Weighted Wire Brush		2	
	Chipping Hammer	4875-555-7829	2	1.70
	Scraper	5110-240-3094	2	.56
	Electrodes	1H-3439-866-2853	80	
*	Electrode Water-proofing material		as req	
	Steel Tubular Electrodes	1N-3439-255-7711	80	1.33
	Waterproofing Material 1. Celluoid dissolved in acetone (1/2 lb per gallon)			
*	Celluiod		as req	
	Acetone	223-2739	as req	1.06
*	2. Waterproof Laquer		as req	
*	Oxy-hydrogen Under-water cutting torch with tips		1	
	Hose (5/16" ID)			
*	red-acetylene		as req	
	green-oxygen	9C-4720-230-6536	as req	
*	black-air		as req	
*	Oxygen Regulator		1	
*	Hydrogen Regulator		1	
*	Underwater Oxy-hydro-gen Cutting-torch Igniter		1	
*	Valve Wrench		1	

ANNEX I - EQUIPMENT

TYPE DESIGNATOR	NOMENCLATURE	FEDERAL STOCK NUMBER	QNTY REQ	PER ITEM COST
Cutting and Welding Equipment (cont'd)				
*	Protective Clothing		as req	
	Oxygen-Cylinders	9G-8120-151-9758	16	25.00
	Hydrogen-Cylinders	9G-8120-151-9754	8	25.00
	Tool Bag	9C-4220-268-9801	2	27.80
	Steel Plate	9Z-9515-153-3236	1	272.00
	Steel Plate	9Z-9515-223-6498	1	69.00
*	O2 Manifold		1	
*	Workbench w/clamp		1	
*	3/4" Anchor Chain		200 ft	
*	Jetting pump		1	
*	2 1/2" Fire Hose		3	
*	Falcon Nozzle		1	
*	Screwdriver, Slotted 8"		1	
	Litharge	6810-247-4310	1	1.38
	Glycerin	6505-153-8220	as req	1.12
	Breastplate Gasket	9I-4220-194-4834		4.20
*	Mandrel			
*	Sanding Block		1	
*	Knife		1	
*	50/50 Soft Solder		as req	
*	Propane Torch Set		1	
*	Flux		as req	
*	1/2" Die		1	
*	Files		1 set	
*	Center Punch		1	
*	Hammer, Rubber		1	
*	Hammer, Hide		1	
*	Hammer,Steel,Claw		1	
*	Adjustable Wrench		1	
*	Soldering Iron		1	
*	Pliers, Needle Nose		1	
	#4 Goodrich Glue	9Q-8040-285-1572	as req	1.44
*	Roller		1	
*	Trichloretholene		as req	
*	Scissors		1	
*	#2B Grommets		as req	
*	#2B Grommet Die		as req	
*	Gasket Punch, 3/8"		1	
*	Neets Foot Oil		as req	
*	Needle		1	
*	#6 Canvas		as req	
*	Sewing Palm		1	

ANNEX I - EQUIPMENT

TYPE DESIGNATOR	NOMENCLATURE	FEDERAL STOCK NUMBER	QNTY REQ	PER ITEM COST
Cutting and Welding Equipment (cont'd)				
	T Wrench	9C-4220-369-4552	1	13.30
*	Scribe		1	
	Flax Packing	9Z-5330-290-5806	as req	.03
*	Bright Work Polish		as req	

* Open Purchase/Local Construction Required
** Price dependent upon attachments (tools) purchased.

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ANNEX I - TRAINING AIDS

NOMENCLATURE	FEDERAL STOCK NUMBER	DEVICE DESIGNATOR NUMBER	QNTY REQ
Cutaway of Mk V Equipment			
Non-Return Valve	C-4220-604-6806		1
Air Control Valve	C-4220-265-6953		1
Airhose	C-4220-230-6531		2
Lifeline	C-5995-184-0096		1
Deep Sea Shoes	C-4220-278-9954		Pr
Exhaust Valve	C-4220-371-8070		1
Chart, Hyperbaric Chamber System	*		1
Chart, Hyperbaric Chamber Piping System	*		1
16mm Film, Swimming for Survival	MN198		1
16mm Film, Oxy-Hydrogen Cutting	MN7851C		1
16mm Film, Oxy Arc	MN7851B		1
16mm Film, Underwater Welding	MN7851A		1
16mm Film, Lightweight Diving	MN9915D		1
Chart/Transparency, Lightweight Mask	*		1
Mk I Mask	*		1
OPNAV Form 9940/1	N/A		16
16mm Film	KN9915A		1
16mm Film	KN9915B		1
16mm Film	KN9915C		1
Single 90 Cutaway	*		1
Single 72 Cutaway	*		1
Manifold Cutaway	*		1
Double Hose Regulator Cutaway	*		1
Single Hose Regulator Cutaway	*		1
Movie Projector 16mm	6730-530-4692	4A1	1
Slide Projector	6730-000-1607	5QQ6	1
Vugraph	6730-527-1916	1BC6	1
Chalkboard	7110-132-6651		1
Swimming Pool			1
SCUBA Slide Presentation	*		1
Vugraph Open Circuit SCUBA Principal	*		1

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ANNEX I - TRAINING AIDS

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NOMENCLATURE	FEDERAL STOCK NUMBER	DEVICE DESIGNATOR NUMBER	QNTY REQ
Vugraph Semi-closed Circuit SCUBA Principal	*		1
Vugraph Closed Circuit SCUBA Principal	*		1
35mm Slides	*		16
Transparancies	*		16
"Dangerous Marine Life" 16mm Movie	MN10697		1
Medical Aspects of Diving, Mech. Effects of Pressure, 16 mm Movie	MN8749 A&B		1
Medicine View Graphs (set of 19)	*		2

* Local Purchase/Construction Required

ANNEX I -- TRAININGS AIDS EQUIPMENT

NOMENCLATURE	FEDERAL STOCK NUMBER	DEVICE DESIGNATOR NUMBER	QNTY REQ
35mm Slide Projector	6730-000-1607	5QQ6	1
16mm Movie Projector	6730-530-4692	4A1	1
Overhead Projector	6730-527-1916	1BC6	1
Resusi-Anne Respiration Trainer	*		1
Chalkboard Easel	*		1
Material for Projects (as described in Diving Training Standards)			
Single Flange	*		1
Pipe Square	*		1
Two-Man Flange	*		1
Seventeen Steel Pontoon	*		1
Tooker Patch Project	*		1
Three-Hole Flange	*		1
12"X12" Lumber	*		6'
Angle Descent	*		1
Hogging Line	*		1

* Local Purchase/Construction Required

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BIBLIOGRAPHY

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ANNEX II - TEXT MATERIALS

MILITARY PUBLICATIONS NUMBER (MILPUBS)	COMPLETE TITLE
NAVSHIPS 0994-001-9010	U.S. Navy Diving Manual, Vol. I & II
NAVSHIPS 0929-000-8010	Underwater Cutting and Welding Technical Manual
NAVSHIPS 0994-007-5010	Instruction Manual, Clayton Diving Heater Model HD-550
Commercial Diving Division, U.S. Divers Co.	Kirby Morgan KMB-9 Band Mask Technical Manual

The U.S. Navy Diving Manual (2 volumes) (NAVSHIPS 0994-001-9010, September 1973) can be ordered directly from:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402

Stock number: C 846-00072

The cost was listed as $16.70 per volume in 1979.

ANNEX II - REFERENCES

MILITARY PUBLICATIONS NUMBER (MILPUBS)	COMPLETE TITLE
NAVSHIPS 0994-001-9010	U.S. Navy Diving Manual, Vol.I
NUC TP 34	Handbook of Dangerous Animals for Field Personnel
NAVSHIPS 0283-206-5405	U.S. Navy Diving Manual (1963)
NAVMED P 5004	Handbook of the Hosipital Corps
NAVSHIPS 0994-008-0100	Self-Contained Underwater Breathing Apparatus Demand Type, Double-Tank Non-Magnetic Aluminum
Unknown	Underwater Work Techniques Manual, Vol. I
NAVSHIPS 0929-000-8010	Underwater Cutting and Welding Technical Manual
NAVSHIPS Tech Manual 9940	9940 Section 2
NAVPERS 10838A	Submarine Medical Practice
BUPERS Article D-2502	BUPERS MANUAL

COMMERCIAL/CIVILIAN PUBLICATIONS

AUTHOR	COMPLETE TITLE, PUBLISHING COMPANY, EDITION, DATE
U.S. Divers Company	1975 Dealers Parts Price List; U.S. Divers Co.; 75; Sept. 25, 1974
Halstead, B.W.	Poisonous and Venomous Marine Animals of the World, Vols. I, II, and III; U.S. Government Printing Office; First Edition 1965
Goldberg, Alan H.	Cardio-pulmonary Arest; New England Journal of Medicine, Vol. 290, No. 7, pp 381-385, 1974

ANNEX II - REFERENCES

AUTHOR	COMPLETE TITLE, PUBLISHING COMPANY, EDITION, DATE
Bennett and Elliot	The Physiology and Medicine of Diving; Williams and Wilkins; First Edition, 1969
Proceedings of Symposium of Underwater Physiology	Human Performance and SCUBA Diving Scripts Institute of Oceanography, 1970
U.S. Divers--Commercial Diving Division	Kirby Morgan KMB-9 Band Mask Manual, U.S. Divers Co., First Edition, 1973
Perry Ocean Engineering	Manual for the U.S. Navy Two Man Open Diving Bell, Perry Ocean Emgineering, 1975

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4-2-1I Instruction, Wrist Depth Gauge, Mk 1, Mod 0
4-3-1I Open Circuit SCUBA Charging
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9-1-10I Diesel Hydraulic Power Unit--NAVSHIPS Model I
9-1-24I Summary of Underwater Tools approved for use by U.S. Navy Divers
9-1-36I Power Velocity Driver (Stud Gun) Firing Procedures

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12-1-1A Hyperbaric Chamber Operation

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12-1-1N Hyperbaric Chamber Operation

FOR OFFICIAL USE ONLY

STUDENT GUIDE

FOR

DIVER, SECOND CLASS (A-433-0022)

MEDICAL DEEP SEA DIVING TECHNICIAN (A-433-0020)

SHIP SALVAGE DIVING OFFICER (A-4N-0011)

DEEP SEA ($He0_2$) DIVING OFFICER (A-4N-0010)

VOLUME A

Physical Conditioning and Mk V Diving System Orientation

PREPARED BY

NAVAL SCHOOL DIVING AND SALVAGE

PREPARED FOR

SERVSCOLCOM, SDIEGO

SUBTRACENPAC, PHARBOR

NAVSCOLDIVSAL, WASH

31 OCTOBER 1975

INFORMATION SHEET 1-1-1I

TITLE: Physical Conditioning

INTRODUCTION

Diving, all types of diving, is a strenuous activity and those engaged in diving must be in excellent physical condition. Not only does diving require strength, as in the case of deep sea diving operations where the equipment may weigh as much as 300 pounds, but diving requires endurance as well. This factor comes into play during SCUBA and deep sea diving activities. There is also the psychological reality that if a person is in good physical condition, you have more confidence in your ability to accomplish tasks whether or not they require physical dexterity.

For these reasons, then, it's important that divers get in shape and maintain a high level of conditioning - during and after training.

This study assignment is designed to acquaint you with the basic physical conditioning program you will be engaged in during your time in training. Maintaining the level is up to you.

ASSIGNMENT SHEET 1-1-1A

TITLE: Physical Conditioning

LESSON TOPIC OBJECTIVES

Terminal Objective
1. When the student completes this course he will have achieved and maintained a level of physical conditioning sufficient to allow him to participate, without undue physical stress, in diving training activities.

Enabling objectives
1. During first week of physical training, run continuously for five minutes and perform five repetitions of each of the exercises included in the program.

2. During the second week of physical training, run continuously for ten minutes and perform ten repetitions of each of the exercises included in the program.

3. During the thrid week of physical training, run continuously for fifteen minutes and perform fifteen repetitions of each of the exercised included in the program

4. During the fourth and succeeding weeks of physical training, run continuously for twenty minutes and perform twenty repetitions of each of the exercises included in the program.

ASSIGNMENT
SHEET 1-1-2A

BODY STRETCHER

V UP AND TOUCH

SIT UPS

FRONT-BACK BENDER

TRUNK TWIST

WHEN DONE ENTHUSIASTICALLY, THE EXERCISES SHOWN ABOVE SHOULD INCREASE ABDOMINAL STRENGTH AND FLEXABILITY.

CAUTIONS: WHEN PERFORMING V-UP AND TOUCH, FLEX NECK AS 1st MOTION IN PERFORMING THE EXERCISE

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ASSIGNMENT
SHEET 1-2-3

Leg lift and body twist

Hello Darling

Flutter kick

Leg lifts

When properly executed, these exercises should build back strength, and increase over-all muscle tone primarily in the back muscles.

CAUTIONS: Hello Darlings – Always flex neck so that chin touches chest. This is done to prevent low back strain.

ASSIGNMENT
SHEET 1-2-4A

EIGHT (8) COUNT BODY BUILDER

PUSH UPS

MOUNTAIN CLIMBER

STEAM ENGINE

PURPOSE: THESE EXERCISES ARE INTENDED TO BUILD STRENGTH IN THE ARMS, SHOULDER GIRDLE MUSCLES AND ABDOMINAL: AND INCREASE OVERALL FLEXABILITY.

METHODS: Pushups and 8 count body builder.
(a) inhale on bringing chest to ground; exhale when pushing.
(b) Touch chest to the ground.
(c) Back strength

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ASSIGNMENT
SHEET 1-2-5A

PROPER RUNNING FORM

THE ENDURANCE RUN IS INTENDED TO BUILD CARDIO-RESPIRATORY ENDURANCE

INFORMATION SHEET 5-1-1I

TITLE: Mk V Deep Sea Diving System (Orientation)

INTRODUCTION

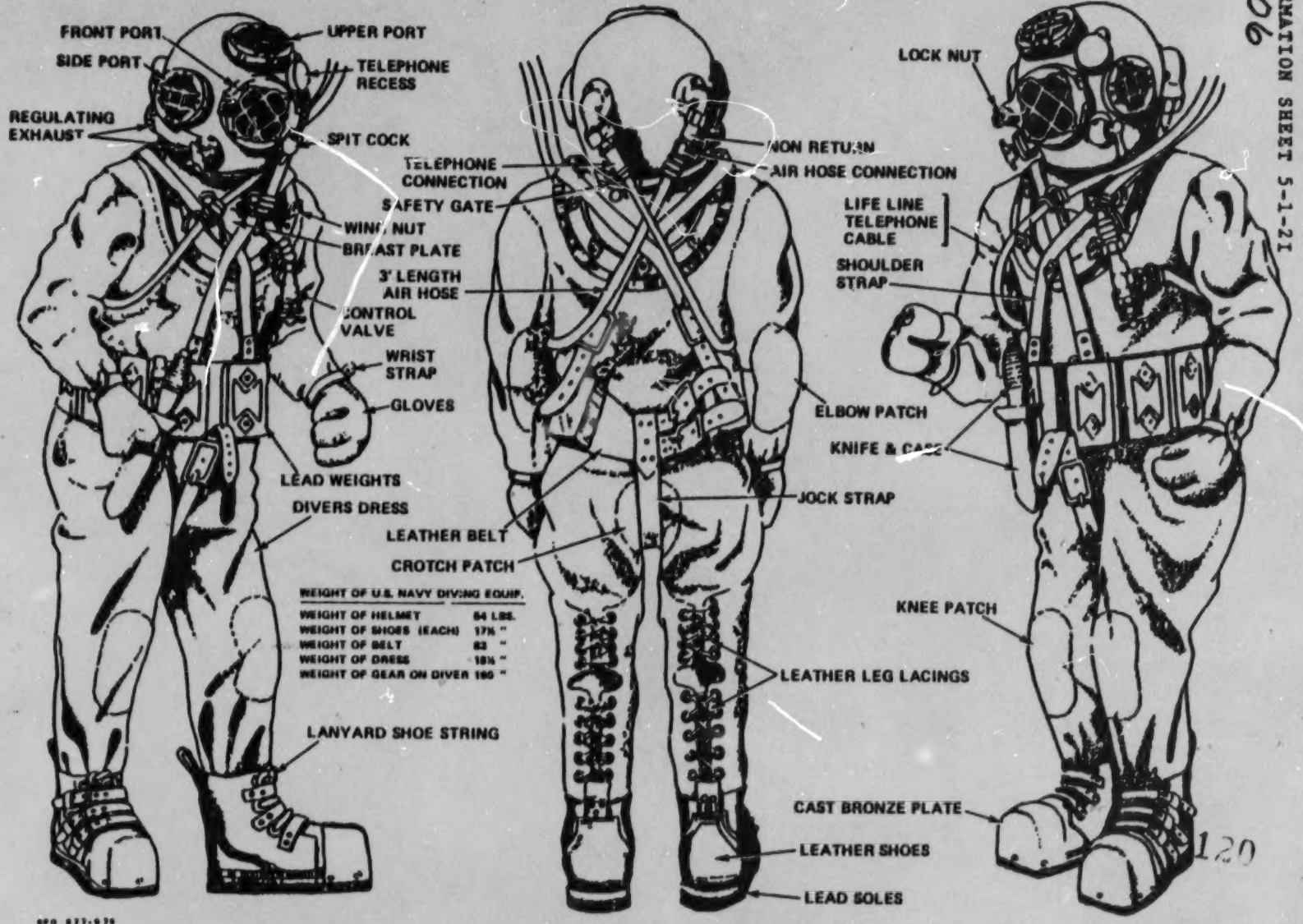
Welcome to the diving community! On Monday morning, you will begin a training course designed to qualify you for an exciting career in diving. The course will offer instruction in the Medical Aspects of Diving, Diving Physics (including decompression), as well as instruction and experience in the Deep Sea, Lightweight and SCUBA Diving Systems.

An important facet of diving is, of course, the equipment and each diver should know and understand every aspect of his equipment - what it is, where it is, how it works, what it does, what it's made of, and how to repair/replace it. Your training course begins with the Mk V Deep Sea Diving System, and this initial assignment is designed to acquaint you with the major components of the system - where they are and what they do. The drawing included with this information sheet shows the physical location of the components, while your reading assignment and related study questions will aid you in learning the function of each component.

REFERENCES

U.S.Navy Diving Manual, Volume I

DEEP SEA DIVING RIG
(COMPLETE)



WEIGHT OF U.S. NAVY DIVING EQUIP.	
WEIGHT OF HELMET	64 LBS.
WEIGHT OF SHOES (EACH)	17½ "
WEIGHT OF BELT	83 "
WEIGHT OF DRESS	18½ "
WEIGHT OF GEAR ON DIVER	160 "

INFORMATION SHEET 5-1-21

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ASSIGNMENT SHEET 5-1-1A

TITLE: Mk V Deep Sea Diving System (Orientation)

LESSON TOPIC OBJECTIVES

Terminal Objectives
1. When the student completes this course he will be able to, given an illustration of the Mk V Deep Sea Diving System, label all major components correctly and explain the function of each.

Enabling Objectives
1. Explain, in writing, the function(s) of the major components of the Mk V Deep Sea Diving System, in terms of what they do for the system.
2. Describe, in writing, the functional and physical location of each of the major components of the Mk V Deep Sea Diving System.
3. List, in writing, the protective devices for the major components of the Mk V Deep Sea Diving System.
4. Describe, through illustration, the flow path of the breathing media through the Mk V Deep Sea Diving System.
5. Orally describe the three types of surface supplied diving rigs.
6. Orally explain the application of the Mk V Deep Sea Diving System.
7. State, in writing, the minimum number of personnel necessary to dive the Mk V Deep Sea Diving System.
8. List, in writing, the advantages and disadvantages of the Mk V Deep Sea Diving System.
9. Orally state the maximum and working depths for the Mk V Deep Sea Diving System.
10. State, in writing, the methods of communication used with the Mk V Deep Sea Diving System.

STUDY ASSIGNMENT

U.S.Navy Diving Manual, Volume I, Chapter 1; Chapter 4, paragraph 4.4 and 4.4.1; and Chapter 6, Introduction, and Paragraph 6.1.1

STUDY QUESTIONS

1. Based upon the Diving Manual's discussion of SCUBA/Lightweight/Deep Sea Diving gear, what would you say is the single most important advantage of the Mk V Deep Sea Diving System? Disadvantage?

ASSIGNMENT SHEET 5-1-2A

2. Define the term, "Surface supplied air diving".

3. The Air Control Valve is a part of which of the following groups?

a. Helmet Group
b. Diving Dress Group
c. Hose Group

4. Describe the function of the Non-Return Valve.

5. What two purposes are served by the Exhaust Valve?

6. At what psi will the Exhaust Valve open fully so that air will be exhausted at a maximum rate?

7. What three purposes are served by the Spitcock (Supplementary Exhaust)?

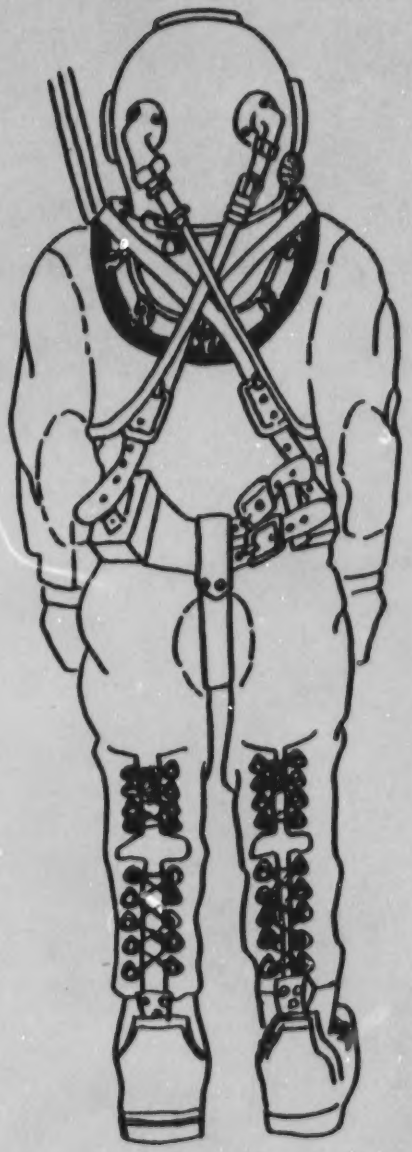
8. What size diving dress would a person 6'2", 200 lbs wear? How would the dress be distinguishable from others?

9. Where is the jockstrap located on the Mk V Deep Sea Diving System? What is its function?

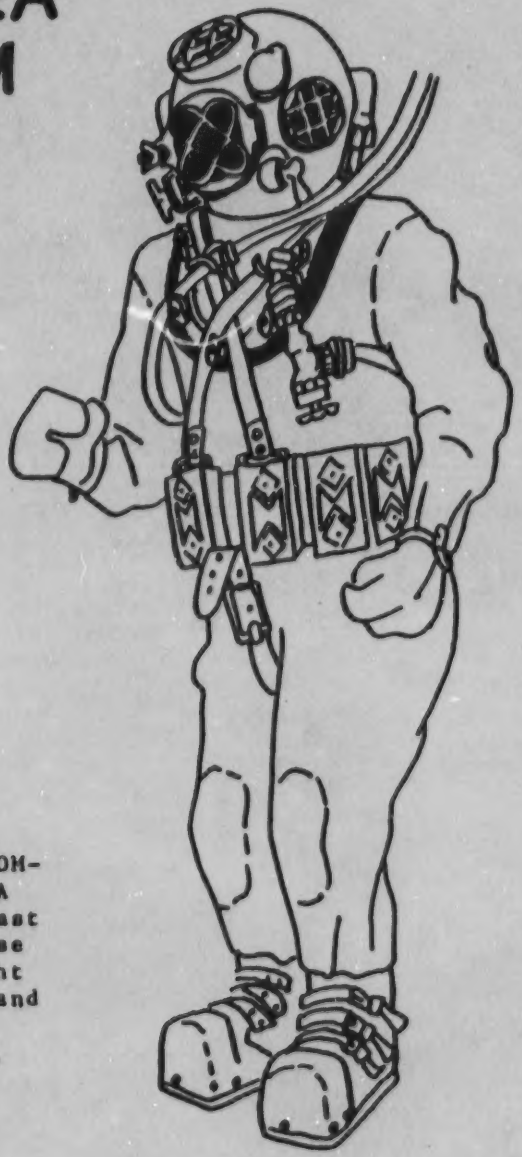
10. How is the depth determined on the pneumofathometer?

NOTE: ASSIGNMENT SHEET 5-1-3A HAS BEEN DELETED; HOWEVER ALL MATERIAL IS INCLUDED.

MK V DEEP SEA DIVING SYSTEM



LABEL THE FOLLOWING MAJOR COMPONENTS OF THE MK V DEEP SEA DIVING SYSTEM: Helmet, Breast Plate, Non-Return Valve, Hose Leader, Exhaust Valve, Weight Belt, Diving Dress, Shoes, and Air Control Valve.



ASSIGNMENT SHEET 5-1-4A

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INFORMATION SHEET 5-2-1I

TITLE: Mk V Deep Sea Diving System Diver (Orientation)

INTRODUCTION

The first time you suit up in a Mk V Deep Sea Diving rig will be like nothing you've experienced before. On the surface, it's cumbersome, terribly awkward and extremely heavy. You'll feel that the guy who invented the thing must have really hated divers. Once in the water, though, the suit's weight is negligible and the only problem for the novice diver is one of dexterity - trying to move and perform work.

With practice and diving experience, it will come to the diver who wants to master the rig. In your training, you'll progress through three units designed to make you relatively proficient in the use of the Mk V System. From that point, you will be able to use the system in other units, such as Cutting and Welding.

The first unit, Orientation, will allow you to get accustomed to the Diving System in a highly controlled environment - the open tank. In ten feet of water, you, as a diver, will complete the Mk V Orientation Dive and some work projects.

The second unit, Underwater Basic, will be your first time in open water and at a depth of at least 30 feet. You'll begin using the Mk V's fine buoyancy adjustments to move along the bottom in the Searching Project and perform several work projects to improve your dexterity.

Then, you will go through Underwater Advanced wherein you will begin to refine your skills and techniques to become proficient. Tunneling, the Hogging Line, and Angle Descent and the Two-Man Pontoon are the projects encountered.

By the time you successfully complete these units, you'll be sufficiently able to use the Mk V Deep Sea Diving System in operational tasks in the fleet. Through the experience gained in the school and the fleet diving operations, you can become a master in the use of the Mk V. GOOD LUCK!!

REFERENCES

U.S.Navy Diving Manual, Volume I
Diving Training Standards

ASSIGNMENT SHEET 5-2-1A

TITLE: Mk V Deep Sea Diving System Diver (Orientation)

LESSON TOPIC OBJECTIVES

Terminal Objectives
1. When the student completes this course he will be able to, as a diver using the Mk V Deep Sea Diving System in an open tank with a minimum of eight feet of water:

a. Demonstrate an ability to use the Mk V Deep Sea Diving System in the underwater environment.
b. Demonstrate all line-pull signals except those used in searching.

Enabling Objectives
1. Describe, orally, the application of equipment associated with the Mk V Deep Sea Diving System.
2. Orally define the terms ventilate and circulate.
3. Orally state the safety precautions associated with the Mk V Deep Sea Diving System.
4. List, in writing, all line-pull signals (except searching) and explain the use of each signal.
5. Use the proper line-pull signals in all training dives.
6. In an open tank, at a depth of at least eight feet, using the Mk V Deep Sea Diving System, perform functions/actions comprising the Mk V Orientation Dive (as described in Diving Training Standards) as directed by the instructor through the phone talker.
7. In an open tank, at a depth of at least eight feet, using the Mk V Deep Sea Diving System, complete the Pipe Square Project in accordance with Diving Training Standards.
8. In an open tank, at a depth of at least eight feet, using the Mk V Deep Sea Diving System, complete the Single Flange Project in accordance with Diving Training Standards.

STUDY ASSIGNMENT

U.S. Navy Diving Manual, Volume I, Paragraph 4.6.3, 4.6.7, 6.1.3, 6.4.3, 6.4.4 and Table 6-3.

STUDY QUESTIONS

1. In an operational dive, the diver must meet three qualifications. List them.

a.

b.

c.

ASSIGNMENT SHEET 5-2-2A

2. The diver is responsible for the diving gear he will use and must be sure that it is _____, in _____ _____ and _____ for _____ anytime.

3. Define the following:

a. Standby Diver:

b. Buddy Diver:

4. The descending line is made of _____ _____ rope, cable-laid to:

5. All underwater lights must be turned on/off underwater. Why?

6. What is the first thing a diver does upon entering the water?

7. Is it possible to swim in a Mk V Deep Sea Diving Rig? Explain.

8. In a current or tideway, what special precautions should be taken by the diver during descent? Why?

9. The maximum rate of descent is _____ feet per minute.

ASSIGNMENT SHEET 5-2-3A

10. Write the following line-pull signals:

a. From diver to tender:

(1) 1 Pull-

(2) 2 Pulls-

(3) 3 Pulls-

(4) 4 Pulls-

(5) 2-1 Pulls-

(6) 3-2 Pulls-

(7) 4-3 Pulls-

b. Special Signals from the Diver

(1) 1-2-3 Pulls-

(2) 5 Pulls-

(3) 2-1-2 Pulls-

c. Emergency Signals

(1) 2-2-2 Pulls-

(2) 3-3-3 Pulls-

(3) 4-4-4 Pulls-

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INFORMATION SHEET 5-3-1I
TITLE: Mk V Deep Sea Diving System Tender (Orientation)

INTRODUCTION

In any surface supplied diving activity, there are two important groups of workers, and it's really difficult to determine which is more important. The two groups are divers and tenders. Perhaps it's not really important to determine which group is on top of the priority list since both are mutually dependent upon the other.

Tenders are responsible for the safety of the diver and to respond to any request for assistance. For training purposes, we'll define the tender as any member of the on-station diving crew except the diver and diving supervisor. In this capacity, tenders keep a written log of the dive, communicate by voice and line-pull signals, standby the diver's umbilical and provide assistance dressing/undressing the diver and getting him in/out of the water.

Those are awesome responsibilities. Because the diver is alone and, at increased depths, decompression stops are necessary, tenders are his only link with the surface world. With them in place properly doing their job, the diver is relatively safe and "the diving team" can respond to any emergency. The important thing is that the tender be aware of his job - how to do it and how important it is to do the job correctly and conscientiously.

The information contained in this assignment will fulfill two functions. First, it will introduce you to tending and teach you some vitally important facets of the job - line-pull signals, phone talking, log-keeping, etc. Secondly, the assignment will provide you an estimate of the importance placed on tending at the school by listing the grading standards.

Your actual tending will be done in stages so that, hopefully, in a short period of time you will be sufficiently adept to properly tend a diver on your own. For example, in this initial week, you will receive instruction and be graded on all line-pull signals except searching, and you will be required to dress a diver within 15 minutes. The other tending functions will be under instructor guidance - in other words, the instructor will tell you what to do or say and you, as tender, simply follow instructions. In later units, you will receive instructions and be graded on the remaining functions.

ONCE YOU HAVE BEEN GRADED SATISFACTORY ON A PARTICULAR TENDING

FUNCTION, YOU ARE EXPECTED TO PERFORM THAT FUNCTION SATISFACTORILY THROUGHOUT TRAINING. This is a rule that will be followed in all classes. Should you deviate from a Satisfactory performance on any function (tending, diving, otherwise), once graded, the instructor will indicate such on a Student Evaluation Sheet and you will be subject to re-evaluation on that particular Terminal Objective. Should you have any questions, please direct them to your Class Proctor or Instructor.

REFERENCES

U.S.Navy Diving Manual, Volume I
Diving Training Standards

DIVING COMMUNICATION STANDARDS

Following are the standards to be used when grading, observing and/or teaching Diving Communications.

LINE-PULL SIGNALS

1. In accordance with the U.S.Navy Diving Manual, Volume I, line-pull signals should be:

a. Sharp, distinct pulls.
b. Strong enough to be felt by the diver.
c. Not so strong as to pull the diver away from his work.
d. Given after all slack has been taken from the line.

NOTE: If the instructor is in doubt as to whether or not tenders are giving proper line-pull signals (as above), place your hand on the line and check for slack, distinctness, etc.

VOICE COMMUNICATIONS

As a Phone Talker

1. Color code first at all times with the exception of telling the diver to circulate.

EXAMPLE: "Red Diver. Coming to your first stop."
EXAMPLE: "Circulate, Red, Circulate."

2. Insure that the diver repeats the given orders verbatim to the phone talker. Repeat the order if not given back verbatim.

INFORMATION SHEET 5-3-3I

3. Repeat, to the diver, any communication from the diver, verbatim.

4. Speak slowly and distinctly. Lower the normal pitch of the voice.

5. Keep conversations brief and simple.

6. Avoid other radio terminology (i.e. Roger, Over and Out, Wilco, etc.)

7. No profanity.

As a diver:

1. Relay information to topside on status of diver and/or task when change occurs.

2. Communications initiated by the diver begins with "Topside, this is (color code) "

EXAMPLE: "Topside, this is Red Diver. On the bottom."

3. Repeat orders given by topside verbatim.

4. Speak slowly and distinctly. Lower the pitch of your voice.

5. Keep conversations brief and simple.

6. Avoid other radio terminology (i.e. Roger, Over and Out, etc.)

7. No profanity.

ASSIGNMENT SHEET 5-3-1A
TITLE: Mk V Deep Sea Diving System Tender (Orientation)

LESSON TOPIC OBJECTIVES

Terminal Objectives
1. When the student completes this course, he will be able to, as a member of a team tending a diver using a Mk V Deep Sea Diving System in an open tank:

a. Demonstrate all tender-to-diver line-pull signals (except searching).
b. Dress a diver in a Mk V Deep Sea Diving System, within 15 minutes, so that he may safely enter the water.
c. Demonstrate proper telephone communication procedures and phraseology, in accordance with Diving Training Standards, under instructor guidance.
d. Demonstrate proper inspection procedures for Exhaust and Non-Return Valves to insure safe operation.
e. Demonstrate maintenance of the Diving Log (including OPNAV Form 9940/1) under instructor guidance.

Enabling Objectives
1. List, in writing, all line-pull signals (except searching).

2. Explain, in writing, the use of all line-pull signals (except searching).

3. Explain, orally, proper phraseology of voice communications used when diving.

4. Explain, orally, proper operation of the diving telephone used for voice communication when diving.

5. Orally explain the proper procedures for dressing a diver in a Mk V Deep Sea Diving System so that he may safely enter the water.

6. As a member of a team of two tenders, practice dressing a diver in a Mk V Deep Sea Diving System.

7. Orally explain the inspection procedures for the Exhaust and Non-Return Valves on the Mk V Deep Sea Diving System, including the importance of the operation and frequency.

8. Practice the operation of the telephone used in voice communication during diving operations. Practice proper phraseology.

ASSIGNMENT SHEET 5-3-2A

9. Practice, under instructor guidance, inspecting the Exhaust and Non-Return Valves on the Mk V Deep Sea Diving System.

10. Orally explain the reason for maintaining a log of diving operations (including OPNAV Form 9940/1).

11. Orally explain the procedures for completing the Diving Log of information on diving activities (including OPNAV Form 9940/1).

12. Practice, under instructor guidance, entering information in a typical diving log and OPNAV Form 9940/1.

STUDY ASSIGNMENT

U.S.Navy Diving Manual, Volume I, Paragraph 4.6.4, 6.3.2, 6.4.1, 6.4.8, Table 6-3 and Figure 6-36.

STUDY QUESTIONS

1. List the tenders' functions before the diver enters the water.

   a.

   b.

2. The tender should be:

   a. a qualified diver
   b. thoroughly briefed by the Diving Officer and Supervisor if a non-diver.
   c. either a or b above.

3. The timekeeper is required to have on hand, a copy of the _____ _____ _____ _____.

4. Who could assume the duties of timekeeper for SCUBA Diving operations? Is it necessary that he be a qualified diver?

5. Describe "line-pull signals".

ASSIGNMENT SHEET 5-3-3A

6. If a tender gives a line-pull signal that is not answered by the diver, what could possibly be wrong?

a.

b.

c.

7. List two line-pull signals which <u>do not</u> have to be answered immediately.

a.

b.

8. How can the tenders prevent the diver from falling when assisting him from the dressing bench to the stage/ladder?

9. The tender should handle the lines from a point at least _____ _____ from the descent line.

10. How much slack should the diver be given throughout a dive?

11. Too much slack in the line will:

a.

b.

c.

12. What actions occur if the diver has not responded to line-pull signals or voice communications?

13. How could you tell, from his bubbles, that a diver has fallen?

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ASSIGNMENT SHEET 5-3-4A

14. Write all tender-to-diver line-pull signals.

a. 1 Pull:

b. 2 Pulls:

c. 3 Pulls:

d. 4 Pulls:

e. 2-1 Pulls:

JOB SHEET 5-3-1J

TITLE: Mk V Deep Sea Diving System Tender
Dressing/Undressing the Diver

INTRODUCTION

The Mk V Deep Sea Diving gear is so large, heavy and awkward that it's impossible for the diver to dress himself. It falls to the tenders, then, to assist the divers from the time he steps into the Diving Dress until he steps out of it again following his dive. There are two important items to remember as you go through this process - diver comfort and SAFETY. It's extremely important that the dress, helmet, breast plate, shoes, weight belt and wrist straps be put on properly. It's important that the air fittings be properly tightened and functioning. The safety of the diver is in your hands. Tenders function as a team, so check each other's work. BE CERTAIN THE DIVER IS SAFE BEFORE LETTING HIM ENTER THE WATER.

When undressing the diver, speed, as well as diver safety, is the key. The diver is tired, having been working, and the suit seems heavier than ever. Later, in training, speed becomes even more important because of the possibility that the diver may require treatment in a Recompression Chamber. That means getting the diver on the surface, up to the diving station, undressed, in the chamber and to depth within five (5) minutes. Although you should direct your practice to this goal, during this Orientation week, concentrate on proper procedures. Don't delay, though, you still have a tired diver who wants that suit OFF!

REFERENCES

U.S.Navy Diving Manual, Volume I

EQUIPMENT AND MATERIAL

Diver, dressed in Diving Underwear and Socks, and Mk V Deep Sea Diving System.

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JOB SHEET 5-3-2J

JOB STEPS

1. Dressing - team of two tenders, one diver.

a. Assist diver into Diving Dress.

b. Lace flaps on back of legs.

(1) Have diver face away from tenders, pull dress up from area of legs by placing hand in crotch, taking any slack out of dress and then leaning on dressing bench with both hands.

(2) Laces should not be tight enough to cut circulation or too loose to permit dead air spaces.

c. Support diver and hold shoes while diver steps into them.

(1) Buckles to the outside.

d. Diver sits on bench while tenders lace, tie, and buckle shoes.

e. Tender in front of the diver brings breastplate over the diver's head and positions it between the diving dress bib and rubber gasket.

f. Place brass shims on studs where straps join. Stow lanyards out of the way behind the diver's neck.

g. Place the four breastplate straps over the breastplate studs. Insure that straps are properly located. (They are marked front, back)

h. Install lug nuts hand tight on all studs. Lug nuts with flanges at strap joints.

i. Using wrench, one tender tighten all lug nuts using alternate tightening sequence. When tightening, tender will keep his hand between breastplate collar and divers chin. Second tender check tightness of all lug nuts. Insure that the rib of rubber gasket is outside of the straps.

j. Remove lug nut from the Bastard Stud and place it, hand tight, on the stud above.

k. Put wrist straps on diver.

l. With diver sitting, tenders position weight belt. One tender buckles strap on back. Insure correct position of shoulder straps (should come across the top outside of the topmost lug nut on either shoulder of the breastplate). Insure jock strap is positioned.

m. Diver stands, placing hand over bastard stud. Tender behind feeds jock strap through the divers legs to front tender. Diver bends forward for buckling of jock strap. Not too tight (voice change) or too loose (able to lift breastplate off shoulders a good distance).

n. Diver sits on bench. Put lanyards down on breastplate away from the collar. One tender steadies diver (from the rear) while second puts helmet into position.

(1) Insure faceplate is closed; lower over head carefully, insure proper alignment.

o. Tender in rear braces the diver (by holding breastplate at shoulders) while front tender turns helmet into correct position.

p. Tender in rear secures Safety Lock. Front tender opens faceplate.

q. Front tender secures Air Control Valve to bastard stud. Tighten lug nut with wrench.

r. Secure air hose and lifeline/telephone cable to breastplate by tying off with lanyards. Take two turns around hose and cable each direction from padeye and secure with a square knot.

s. Set Exhaust Valve 2 1/2 turns from fully closed position. Open Supplementary Exhaust. Inform diver the Exhaust Valve is set and Supplementary Exhaust is open.

t. Close and secure faceplate.

u. Front tender holds umbilical as close as possible to the breastplate. Rear tender holds helmet goosenecks. Front tender pat divers helmet two times as signal to stand. Lead diver to ladder or stage.

2. Undressing - team of two tenders, one diver

a. Front tender holds umbilical as close to breastplate as possible. Rear tender holds helmet goosenecks as diver steps on deck. Lead diver to dressing bench, pat helmet two times as signal to sit.

b. Front tender open faceplate.

(1) Diver reports, "Faceplate open! Diver O.K.!"

c. Front tender loosens both knots on Air Hose and Lifeline/ Telephone Cable.

d. Front tender removes lug nut from Bastard Stud to remove Air Control Valve. Rear tender unlocks Safety Lock by removing cotter pin and opening hasp.

e. Rear tender braces diver by holding shoulders of breastplate. Front tender closes faceplate and removes helmet by turning it counter-clockwise 1/4 turn and lifting it carefully off diver's head.

f. As soon as the helmet is clear, rear tender unbuckles the four buckles on the weight belt.

g. Both tenders (one on each side of the diver) grasp the weight belt at the shoulder strap-belt junction and at bitter ends (remove jock strap eye). Diver raises slightly to free jock strap as tenders take weight belt forward and away.

h. With one tender in front and one in rear, begin loosening lug nuts.

i. Remove lug nuts, straps, and shims.

j. Both tenders begin in front and remove diving dress gasket from breastplate studs by pulling the gasket up and over the studs evenly on each side so that both tenders end together at the rear. The gasket should now be under the breastplate.

k. Front tender remove breastplate by lifting it over diver's head carefully.

l. Tenders unbuckle, untie and remove diver's shoes.

m. Remove wrist straps.

n. Diver stands, turns around and bends over bench. Tenders unlace diving dress legs. Remove laces completely.

o. Diver stands upright. One tender on each side pulls gloves off diver's hands and arms. Once dress is clear of arms, one tender holds diver under the arms while the other removes the diving dress by pulling on the dress boots.

p. Stow equipment properly or prepare it for the next dive.

SELF TEST ITEMS

1. Are you and your partner coordinating your efforts so that there is little or no wasted motion and both are working?

2. Are you thorough in completing your procedures?

3. Are you keeping the safety of the diver uppermost in your mind?

JOB SHEET 5-3-6J 126

TITLE: Mk V Deep Sea Diving System Tender (Orientation)
Exhaust and Non-Return Valve Inspection Procedures

INTRODUCTION

To insure the safety of the diver while on the bottom, it's necessary that his equipment be functioning properly and that there is a strong probability that it will not malfunction. An important part of this insurance are the routine inspections performed prior to each day's diving. This Job Sheet provides detailed instructions regarding the inspection of two important components of the Mk V System. The Exhaust Valve keeps air circulating through the system by maintaining 1/2 pound pressure in the diving dress unless manually over-ridden by the diver using the chin button. The Non-Return Valve does not allow air to escape from the helmet/dress back up the umbilical should it be severed or something happen to disrupt the topside source of air. This could have extremely adverse effects should the Non-Return Valve malfunction and the air supply be disrupted.

It's important that these inspections be performed conscientiously and thoroughly because the diver's life is literally dependent upon your work. It's also important that you cultivate the habit of inspecting the components of the Mk V Deep Sea Diving System- all the components- as you're working with them. Should you find something needing repair or replacement, do it then. Should the repair necessitate holding up the dive for an extended period of time, replace the affected component and, at the first opportunity, fix it! Don't put it off!

REFERENCES

U.S.Navy Diving Manual, Volume 1

EQUIPMENT AND MATERIALS

Mk V Deep Sea Diving System, Common Screw Driver, Adjustable wrench, bucket, cleaning cloth

JOB SHEET 5-3-7J

JOB STEPS

1. Exhaust Valve Inspection

a. Before each day's diving

(1) Remove two screws from bonnet guard.

(2) Remove bonnet guard.

(3) Using an adjustable wrench, remove bonnet.

(4) Hold valve stem and unscrew chin button, removing it.

(5) Lift out valve stem assembly.

(6) Inspect valve disc and seat for dirt, scratches, growth, etc. Clean, lap in, or replace as necessary.

(7) Inspect primary and secondary springs for tension. Replace as necessary.

(8) Reassemble in reverse order of disassembly. Be sure parts are properly placed. If in doubt, check diagram in U.S. Navy Diving Manual, Volume I, Page 6-46.

(9) Set Adjusting Handwheel at fully closed position.

(10) Open Adjusting Handwheel 1/8 turn.

(11) Gently tap chin button with one finger. If the valve is properly assembled, you should feel a slight travel before the chin button assembly stops against the secondary spring follower disc.

(12) If the above inspection indicates improper assembly, the valve must be disassembled and the adjusting sleeve reset. This will be done only with guidance from the instructor.

b. Prior to each dive:

(1) Set Adjusting Handwheel at fully closed position.

(2) Perform inspection as in (10) and (11) above.

(3) Open Exhaust Valve 2 1/2 turns from fully closed position as indicated in Mk V Deep Sea Diving System Dressing procedures.

JOB SHEET 5-3-8J 128

2. Non-Return Valve

a. Prior to each day's diving:

(1) High Pressure Test

(a) Install valve backwards in an air hose.

(b) Pressurize to at least 100 psi.

(c) Submerge the valve in a bucket of clean water.

(d) Check for any signs of leaking air (bubbles).

(e) If leak is indicated:

Spring and Stem Type - disassemble and replace spring and/or seat as necessary.

Cartridge Type - replace cartridge and O-ring.

(2) Low Pressure Test

(a) Blow smoke through the valve in both directions.

(b) It should flow easily in the proper direction (to the helmet)

(c) There should be no smoke emerging when blown in the opposite direction.

(d) If a leak is indicated, take action as in (e), above.

SELF TEST ITEMS

1. Are you being thorough in your inspection of the valves, looking for scratches, dirt, growth, etc. which may impair the functioning?

JOB SHEET 5-2-1J

129

TITLE: Mk V Deep Sea Diving System Orientation Dive

INTRODUCTION

This initial dive using the Mk V Deep Sea Diving System is designed to acquaint you with the feel and operation of the equipment. You'll have the opportunity to perform functions and maneuvers that will possibly seem strange and not very useful, but it's only to demonstrate the capability of the gear and to build some confidence in your ability to use it.

REFERENCES

U.S.Navy Diving Manual, Volume 1
Diving Training Standards

EQUIPMENT AND MATERIAL

Diving Underwear, Diving Socks, Mk V Deep Sea Diving System

JOB STEPS

1. Primary

a. Diver enters water via ladder.
b. Diver stops descent when water is at faceplate level to close the Supplementary Exhaust.
c. Diver reports (line-pull signal and voice communication) leaving the surface and arrival on bottom.

2. System Checkout - remainder of the operation will be performed at the direction of the instructor through the phone talker or tenders (line-pull signals).

a. Ventilate - open Air Control Valve and depress Chin Button.
b. Circulate - Reset Air Control Valve to normal rate and release Chin Button.
c. Stand in the center of the open tank facing the instructor.
d. Open Supplementary Exhaust (Spitcock).
e. Close Supplementary Exhaust.
f. Secure Air Control Valve
g. Open and reset Air Control Valve.
h. Lie down on back, roll to stomach, and then to right side.
(1) While on right side, open and secure Supplementary Exhaust.
i. Crawl around the open tank on hands and knees twice.

j. Lie down in the center of the tank on your back.

k. Using your mouth, pull in chin button so that you come to a standing position without using your hands.

l. Make a controlled ascent.
   (1) Pull in chin button using mouth.
   (2) Increase air by opening Air Control Valve slowly.
   (3) Break surface with helmet and remain in a vertical position for 30 seconds.

m. Secure from system checkout.
   (1) Release chin button.
   (2) Reset Air Control Valve to normal flow rate.

n. Line-Pull Signals
   (1) Diver will initiate or respond to all line-pull signals (except searching) not previously used at the direction of the instructor.

o. Diver will give proper line-pull signals and ascend the ladder.

p. On the surface, with water at faceplate level, stop to open Supplementary Exhaust.

q. Secure Air Control Valve.

r. Proceed up ladder and out of open tank.

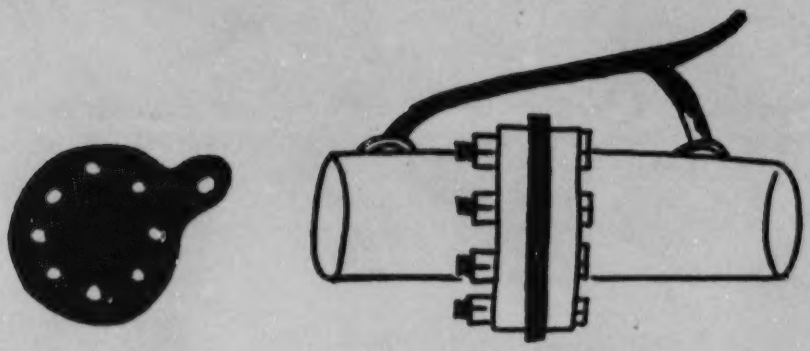
SELF TEST ITEMS

1. Prior to descent, while on the ladder, diver should insure that everything feels relatively comfortable (i.e. toes aren't cramped, helmet isn't at an awkward angle, etc.).
2. Check for proper air flow - adjust by open/closing Air Control Valve.
   a. Underinflated
      (1) Diving dress will be "squeezing" arms, legs, etc.
      (2) Helmet will seem heavy.
      (3) Faceplate fogging
   b. Overinflated
      (1) Inability to grasp anything or to move arms.
      (2) Positive Buoyancy
3. Communications
   a. It may be necessary to partially close Air Control Valve to hear voice communications.
   b. Diver line-pulls should be sharp distinct pulls (see Information Sheet 5-3-1I)
   c. Be aware of the tender's line-pull signals.

JOB SHEET 5-2-3J

131

TITLE: Mk V Deep Sea Diving System Orientation Single Flange Project



INTRODUCTION

This will be your first experience at performing work in the Mk V Deep Sea rig. It's difficult and, sometimes, frustrating, but not impossible. It does require an adjustment by the diver because a task that seems simple on the surface becomes difficult in a heavy awkward suit in ten feet of water. You have to adjust to the suit by making yourself think through the problems you encounter, making your movements and mechanical actions deliberate as well as learning to work in the diving gloves. Working underwater is somewhat a problem due to refraction - things will seem closer than they actually are. So take your time, and be patient. It can be done in the time allotted.

By the way - working in the open tank will seem relatively easy later in your training. At least you can see what you're working with unlike open water diving where you'll be working with little or no visibility. So, enjoy it now!

REFERENCES

Diving Training Standards

EQUIPMENT AND MATERIALS

Diving Underwear, Diving Socks, 2 Open End Wrenches, Tool Bag, Mk V Deep Sea Diving System, and Single Flange Project.

JOB STEPS

1. Diver uses correct line-pull/voice communications and descends to the bottom of the open tank via ladder.
2. Get equipment squared away and standby project.

JOB SHEET 5-2-4J 132

3. Disassembly

   a. Remove nuts, bolts and gasket.
      (1) Put nuts and bolts in tool bag.
   b. Send for square mark (via line-pull signals).
   c. Secure gasket to square mark and send it topside.
   d. Recover gasket from topside.

4. Reassembly

   a. Replace nuts and bolts after putting gasket in place.

5. Use proper line-pull/voice communications and come to surface via ladder.

SELF TEST ITEMS

1. Is the air flow properly adjusted?

2. Prior to securing nuts and bolts during reassembly, are the bench marks properly aligned?

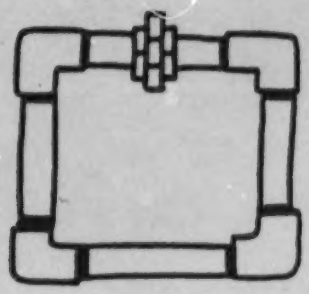
3. Are at least six nuts and bolts wrench tight?

4. Underwater work should be done as quickly, thoroughly and deliberatly as possible. Although the project completion times can be met by a majority of students without a great deal of strain, each indiwidual should strive to perform the task as efficiently (fast) and effectively (all parts properly in place) as he possibly can. By doing this from the beginning, he forms a habit of working quickly and thoroughly, thus becoming a much better diver.

JOB SHEET 5-2-5J

133

TITLE: Mk V Deep Sea Diving System Orientation Pipe Square Project



INTRODUCTION

This project is designed to require a bit more manual dexterity than the Single Flange Project. You will be putting the pieces of an object together underwater using only your hands. Like all the projects in your training, you should work as quickly as possible, but be thorough.

REFERENCE

Diving Training Standards

EQUIPMENT AND MATERIAL

Diving Underwear, Diving Socks, Tool Bag, Mk V Deep Sea Diving System, and Pipe Square Project material.

JOB STEPS

1. Diver gives proper line-pull/voice communication and descends to bottom of tank, via ladder, with pieces of Pipe Square Project in tool bag.
2. Place three long pipe pieces along side each other on deck.
3. Place four elbows in similar area.
4. Hold one long pipe piece and secure an elbow to each end, then back the elbows off one complete turn.
5. Screw remaining long pipe pieces (2) into secured elbows.
6. Secure the remaining elbows (2) to the two pipes, being sure that the elbows are aligned.
7. Remove short pipe pieces from tool bag and screw into open elbows.
8. Screw union end on one short pipe.

9. Place union ring on remaining short pipe piece with threads facing the center of the joint.
10. Screw tail piece onto same pipe as union ring with seat facing joint.
11. Screw union ring onto union end of opposite pipe.
12. Give proper line-pull signals/voice communications and ascend via ladder, bringing tool bag and assembled Pipe Square Project to surface.

SELF TEST ITEMS

1. Is the project together hand tight?

NOTETAKING SHEET 5-1-1N
TITLE: Mk V Deep Sea Diving System (Orientation)

REFERENCES

U.S.Navy Diving Manual, Volume I

NOTETAKING OUTLINE

I. Introduction

A. Types of Surface Supplied Diving Rigs

1.

2.

3.

4. Surface Supplied means:

B. Flow Path of Breathing Media

1. Low Pressure Air Compressor

a. through a _____ (removes impurities) to the

b. _____ tank - air is _____ and _____ until needed - through a

2. High Pressure Air Compressor

a. through a _____ to a

b. _____ _____ _____ tank

3. Diver's Air must meet:

a. established standards of _____ - filtered.

b. adequate _____

NOTETAKING SHEET 5-1-2N

c. adequate _____ _____ (cfm)

(1) proper _____ of helmet or mask

d. Overbottom Pressure

(1) up to _____ ft. - _____ lbs over

(2) over _____ ft. - _____ lbs over

e. _____ _____ system

C. Application of Mk V Deep Sea Diving System

1. Operations in Deep Water

a. Normal Working Depth - _____ ft for _____ minutes.

b. Maximum Working Depth-_____ ft for _____ minutes (exceptional exposure)

2. High degree of _____ and _____.

a. Heavy _____ work.

b. Underwater _____.

D. Advantages

1. Unlimited _____ _____.

2. Maximum _____ and _____ protection.

3. _____ and _____ _____ communication.

4. Works in current up to _____ knots.

5. Variable _____.

E. Disadvantages

1. Slow _____

2. Poor _____

3. Large _____ _____ and _____ requirement

4. _____ (_____lbs)

NOTETAKING SHEET 5-1-3N

1. Hose

   a. provides surface supplied _____ to _____.

   b. fittings are secured with _____ hose clamps.

      (1) fittings are _____ threads per inch

   c. and is secured to diver's _____ _____ with _____.

   d. _____ ft. lengths _____ inch outside diameter, _____ inch inside diameter.

   e. made of _____ type, vulcanized _____ tube reinforced.

2. Lifeline and Telephone Cable

   a. provides safety to diver

      (1) means of _____ diver up

      (2) means of _____ between diver and _____.

NOTETAKING SHEET 5-1-4N

b. runs from surface to diver's _____ where it is secured with a _____ and connected to the _____ _____ of helmet.

(1) Takes _____ off air hose

(2) Tied (_____) to air hose

c. Breaking strain _____ lbs. and, with coupling installed, _____ lbs.

d. Core consists of _____ inch corrosive resisting _____ cable coated with high grade _____ cover.

(1) _____ electrical wires for communications

(2) Cover is _____ resistent _____ jacket.

e. _____ ft and _____ ft lengths

Air Control Valve
(darkened)

1. Function

a. Provides a _____ means for diver to control air into the _____ at a _____ he _____.

b. Turn toward diver - _____ air.

c. Turn away from diver - _____ air.

2. Location

a. Above the _____ on the _____ front of the diver.

b. Within easy reach by _____ hand.

c. Connected to the end of the _____ hose from the surface and the three foot of hose to _____.

d. Secured to _____ with flexible _____ on valve.

3. Protective Devices

a. Hand wheel is provided with a securing _____ with a cotter _____ going through _____ and valve stem.

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NOTETAKING SHEET 5-1-6N

b. Securing bracket to hold _____ nut in place.

d. With valve all the way open, a minimum of _____ threads will be engaged.

4. Material

a. _____ - because of use in salt water.

b. Two _____ fittings for hose connectors.

NOTETAKING SHEET 5-1-7N

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Hose Leader
(darkened)

1. Function

   a. Connects _____ supply from _____ _____ _____

to non-return valve on _____.

2. Ratings

   a. _____ length, _____ inch outside diameter,

_____ inch inside diameter.

   b. _____ female fittings with _____ hose clamps.

3. Material - same as _____ _____ _____

   a. sinking type

   b. vulcanized rubber tubing reinforced

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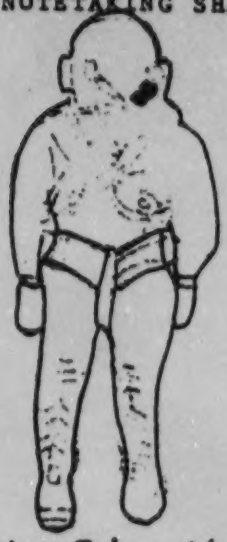
NOTETAKING SHEET 5-1-8N



Non-Return Valve
(darkened)

1. Function

   a. Prevents loss of _____ from diving _____ and _____, in case of air supply _____ or hose _____.

   b. Prevents possible _____ _____ to the diver.

   c. One-way _____ _____ for helmet.

2. Location

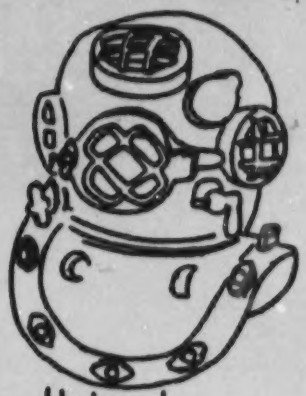
   a. Attached to _____ _____ (air hose fitting).

3. Two Types - bodies are made of _____; female end has a _____ washer.

   a. _____ and _____ - leather washer seat and a spring.

   b. _____ - has a cartridge and ____-_____ seal.

NOTETAKING SHEET 5-1-9N



Helmet

1. Function

   a. Fits over divers head to provide protection.

   b. Air Supply enters through _____ on _____ rear side of helmet and is circulated around diver's _____.

   c. Houses _____ for communication with topside. Located _____ _____ _____ of helmet.

   d. Secured to breastplate by _____ _____ _____ at base.

2. Protective Devices

   a. Ports

      (1) _____, heat treated _____ view ports

         (a) front port is on a _____ pin and can be _____. In closed position, it is secured with _____ _____ nut.

         (b) _____ _____ and _____ _____ forms a water-tight seal.

      (2) Ports have _____ _____ guards to prevent _____.

   b. Safety Lock (_____)

      (1) Prevents helmet from _____ on breastplate.

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(2) Located on _____ of helmet.

(3) Fits into recess on _____ and locked into _____ position. Held closed by swing _____ and _____ _____ of breastplate.

NOTETAKING SHEET 5-1-11N

Exhaust Valve
(darkened)

1. Function

   a. release _____ _____ from helmet and diving dress.

2. Maintains at least _____ pound _____ pressure in the suit when the valve is opened _____ turns.

3. Handwheel cannot be opened more than _____ turns from fully closed position.

4. Provides a controlled _____ _____ _____ valve to expell air without allowing _____ _____ _____.

5. Chin Button on _____ of helmet is controlled:

   a. pull in to _____ air.

   b. push out to _____ air.

6. Made of _____ _____.

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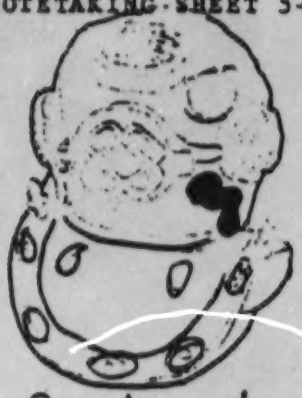
NOTETAKING SHEET 5-1-12N



Supplementary Exhaust Valve (darkened)

1. Function

   a. minor _____ _____

   b. auxilliary _____ when diver is working on his _____ _____.

   c. Used for _____ of water collecting in the bib of the diving dress.

2. Located on lower _____ _____ of the helmet.

3. _____ turn _____ type

4. _____ while diver is on the surface.

NOTETAKING SHEET 5-1-13N

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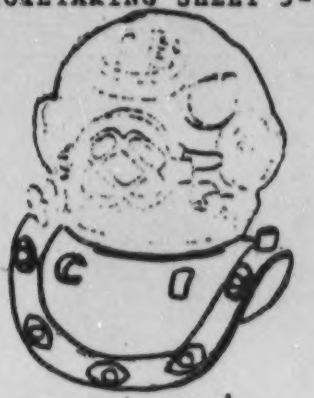


Breast Plate
(darkened)

1. Function

a. Secures _____ to _____ _____.

(1) fits over diver's head and rests on his shoulders.

(2) helmet is screwed on and forms a water-tight seal by a _____ _____ recessed in the top of the breastplate.

b. _____ padeyes are located on the _____ with signal halyard through each.

(1) _____ _____ is secured on the left.

(2) _____/_____ _____ is secured on right.

2. _____-_____ inch _____ evenly spaced around the breastplate to accept the _____ _____ of the diving dress.

a. _____ bronze _____ are used to make a water-tight seal between breastplate and diving dress.

(1) THESE ARE SERIALIZED AND ARE NOT INTERCHANGEABLE WITH OTHER BREASTPLATES.

NOTETAKING SHEET 5-1-14N 148

3. Wing Nuts - _____ each, bronze.

a. _____ flanged wing nuts are used a breastplate _____ _____.

b. _____ regular wing nuts. One on _____ stud is used to secure flexible link of _____ _____ _____ to breastplate.

5. Material

a. Helmet/Breastplate made of _____ _____ and _____.

(1) Gives _____ and weight

b. Fittings made of _____ _____

(1) _____ metal

(2) _____ _____ to helmet.

Diving Dress
(darkened)

1. Function - provides a _____ working environment and _____ from underwater _____. Used with diving underwear, provides protection from _____.

2. Reinforced at areas of stress: _____, _____, _____, and _____.

3. _____ sizes marked by the number of _____ located in the back part of the _____.

   a. No. _____ is small (_____ grommet) - for divers _____ to _____.

   b. No. _____ is medium (_____ grommets) - for divers _____ to _____

   c. No. _____ is large (_____ grommets) - for divers _____ to _____.

NOTETAKING SHEET 5-1-16N 150

4. Have either _____ or _____ cemented to dress. Dress, with gloves, is held to diver's wrists by _____.

   a. decrease _____ in the gloves, easier to _____.

5. Top of dress has a _____ _____ sewn and cemented to it, fitted with holes to accept the _____ _____.

6. _____ is to catch small amounts of _____ and allow it to be expelled through the _____ _____ _____.

7. Lacing flaps are located on the _____ _____ of _____ to prevent accumulation of _____ in the _____ _____ of the diving dress.

   a. Always laced with _____ prior to entry into the water.

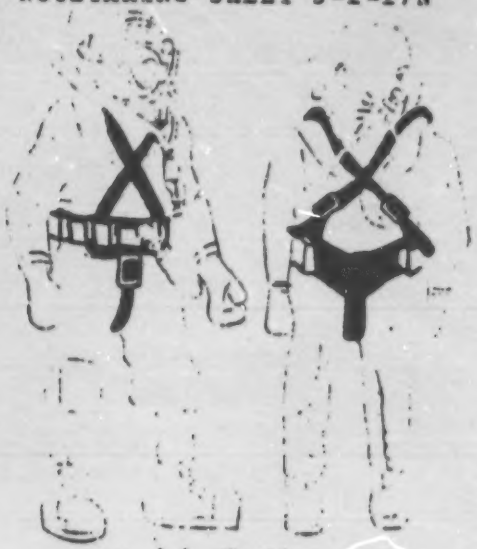
8. Dress is made of _____ _____ _____ between _____ layers.

   a. _____

   b. _____ _____

   c. Relatively _____ _____

NOTETAKING SHEET 5-1-17N



Weight Belt
(darkened)

_____ pounds, ten _____ pound _____ weights.

1. Function

a. Provides _____ _____

b. Worn _____ around waist.

2. Held in place by _____ _____ and _____ _____.

a. _____ _____ is used to hold the weight down on the diver's shoulders, thus holding the _____ down also.

b. _____ _____ is tested each day before use by applying a strain of at least _____ pounds.

3. Made of _____ _____, _____ leather.

a. Belt and jock strap must be wiped down after _____ _____ diving with _____ _____ _____ to preserve leather.

NOTETAKING SHEET 5-1-18N 152

Diving Shoes
(darkened)

1. Function

a. Provide _____ _____ and assist in preventing the diver's _____ from _____ _____ than his _____.

2. _____ size - weight is _____ pounds per pair.

3. _____ _____ safety toe, _____ bottom sole, _____ _____ inner sole and _____ _____ tops.

NOTETAKING SHEET 5-2-1N
TITLE: Mk V Deep Sea Diving System Diver (Orientation)

REFERENCES

U.S.Navy Diving Manual, Volume 1

NOTETAKING OUTLINE

A. Equipment associated with the Mk V Deep Sea Diving System

1. Descending Line

a. ____ _____ rope

(1) Left-laid cable - prevents diver from _____ around descent line.

(2) Used to:

(3) May be tied to underwater object or _____.

2. Distance Line

a. _____ feet of _____ thread.

b. Tied to _____ end of descent line.

c. Used for _____ and _____ descent line.

3. Stage

a. Used to divers in the water or bring them out.

b. _____ or _____ man models.

4. Stage Line

a. _____ or _____ inch manila or nylon.

b. Marked at _____ feet intervals

c. Used to:

NOTETAKING SHEET 5-2-2N

5. Diving Ladder

a. Used when entering/exiting water along side a small boat.

b. Made of _____ _____.

6. Descending Weights

a. Place on the bottom of the descending line to _____ _____ _____ _____.

b. _____ and _____ lb cast iron.

7. Underwater Lights

a. May increase _____ of vision.

b. Hand held, _____ operated.

(1) Medium pressure up to _____ feet.

c. Electric

(1) 150 feet - _____ watt photo bulb

(2) 500 feet - _____ watt lamp

d. Lights must be turned on and off _____ because of _____ _____ to bulb.

8. Tool Bag

a. Made of _____ with drain holes.

b. Looped over the diver's arm or sent down descent line

9. Air Wrenches

a. _ _____ open end

b. _____ required

c. Used to connect diver's _____ _____, _____ _____ _____ and _____-_____ _____.

10. Telephone Wrench

a. _____ open end.

b. Connects _____/_____ to helmet gooseneck.

11. Horse Collar

a. _____ for breastplate

b. Fits over diver's _____.

c. Helps prevent _____ _____ on shoulders.

B. Ventilate/Circulate

1. Ventilate

a. Allows _____ _____ of air inside _____

(1) _____ Air Control Valve and depress _____ _____

2. Circulate

a. Return to _____ _____ _____.

3. When used:

a. When diver first reaches the _____.

b. At _____ when diver is working.

c. In the event of a _____ _____.

d. Normally directed by _____, but taken as needed.

C. General Safety Precautions

1. Must have a _____ _____ dressed topside and ready to go.

2. If diving _____ feet and over, must have a _____ and Diving _____ _____ available.

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NOTETAKING SHEET 5-2-4N

3. Take air samples _____.

4. _____ air system.

5. Do not dive a man who does not _____ _____.

6. _____ dives thoroughtly.

7. Must have adequate _____ _____ for _____ of dive.

NOTETAKING SHEET 5-3-1N
TITLE: Mk V Deep Sea Diving System Tender (Orientation)

REFERENCES

U.S.Navy Diving Manual, Volume I

NOTETAKING OUTLINE

A. Standard Line-Pull Signals

1. From tender to diver

a. 1 Pull -

(1) On descent -

b. 2 Pulls -

(1) On ascent -

c. 3 Pulls -

d. 4 Pulls -

e. 2-1 Pulls -

2. From diver to tender

a. 1 Pull -

b. 2 Pulls -

c. 3 Pulls -

d. 4 Pulls -

e. 2-1 Pulls -

f. 3-2 Pulls -

g. 4-3 Pulls -

3. Emergency Signals

a. 2-2-2 Pulls -

b. 3-3-3 Pulls -

c. 4-4-4 Pulls -

d. RULE: ALL LINE-PULL SIGNALS WILL BE ANSWERED AS GIVEN EXCEPT THE EMERGENCY SIGNAL _____.

NOTETAKING SHEET 5-3-2N

4. Special Signals from the diver

a. 1-2-3 Pulls -

b. 5 Pulls -

c. 2-1-2 Pulls -

B. Valve Inspections

1. Exhaust Valve

a. Set _____ _____

b. Correct setting is:

c. Check chin button for:

d. Tell diver prior to closing the faceplate that:

2. Non-Return Valve

a. Check before _____ _____ diving.

b. Smoke Test - blow cigarette smoke through _____ end. Watch for:

c. Low Pressure Air Test - use _____ to _____ lbs of air pressure through _____ end of valve and place it in a bucket of water. Check for:

STUDENT GUIDE

FOR

DIVER, SECOND CLASS (A-433-0022)

MEDICAL DEEP SEA DIVING TECHNICIAN (A-433-0020)

SHIP SALVAGE DIVING OFFICER (A-4N-0011)

DEEP SEA ($He-O_2$) DIVING OFFICER (A-4N-0010)

VOLUME B

Diving Physics

PREPARED BY

NAVAL SCHOOL DIVING AND SALVAGE

PREPARED FOR

SERVSCOLCOM, SDIEGO

SUBTRACENPAC, PHARBOR

NAVSCOLDIVSAL, WASH

31 OCTOBER 1975

160 ASSIGNMENT SHEET 2-1-1A

TITLE: Diving Physics/Decompression Charting

LESSON TOPIC OBJECTIVES

Terminal Objectives
1. When the student completes this course, he will be able to, given the following diving situations:

Normal working dive to include depth, job, bottom time and water decompression.

Normal working dive to include depth, job bottom time and surface decompression.

Normal working dive to include depth, job, bottom time and surface decompression, O_2.

Perform necessary computations correctly, select proper descent/ascent rates, select proper decompression schedules and, using the information, complete the Diving Chart and, if applicable, Repetitive Dive Worksheet.

Enabling Objectives.
1. Define and describe, in writing, terms used in diving physics.

2. Describe, in writing, the following as to how they affect the diver underwater:

a. Boyle's Law
b. Charles' Law
c. Dalton's Law
d. Henry's Law
e. Heat Transfer
f. Sound Transmission
g. Light Refraction

3. Decompression Schedules:

a. Orally list the name of each table in Air and 02 decompression.
b. Orally explain the application of the Repetitive Dive Worksheet, recompression chamber, breathing medias, depth gauges, and time pieces.
c. Describe, in writing, how the use of various diving equipment affects decompression.
d. Define, in writing, selected terms as used in air decompression.
e. Describe, orally, the sequence of computation for determining the decompression schedule for a repetitive dive.

f. Describe, orally, the sequence of computation for determining the selection of the proper decompression schedule and the rate of ascent to the first stop.

g. Orally explain the need for decompression and decompression schedules.

h. Orally explain the limits imposed by the utiliztion of oxygen for decompression.

i. Orally describe the conditions under which the need for additional decompression other than that computed would be used.

j. Orally describe the fundamentals involved in decompression when high altitude diving.

k. Describe, in writing, the most vital requirement of breathing media composition, depth and time.

l. Orally describe the basic types of decompression tables.

m. Navy Decompression Tables (Air) Systems

(1) For the following:

(a) Decompression Procedures
(b) Standard Air Decompression Schedules
(c) No-decompression limits
(d) Surface Interval Credit
(e) Repetitive Dive Time Table
(f) Exceptional/Extreme Exposure
(g) Surface Decompression Using O_2
(h) Surface Decompression Using Air
(i) Nitrogen-Oxygen Equivalent Air Depth Table
(j) Nitrogen-Oxygen Equivalent Exceptional Exposure
(k) Oxygen Depth Time Limits
(l) Diving Charts

(2) Orally explain the function(s), source of information required for use, application or use and a description of the component.

(3) Orally describe the physical location of each component part (section) within the major component and explain the application or use of the component part.

(4) Orally describe how each component contributes to the control accomplished by the use of the decompression schedule system.

(5) Work, in writing, a hypothetical dive using the Standard Decompression Schedule.

(6) Work, in writing, a repetitive dive using the Repetitive Dive Worksheet.

(7) Work, in writing, a surface decompression dive using oxygen.

(8) Work, in writing, a surface decompression using Air.

(9) Orally describe the use of the Nitrogen Air Equivalent Air Depth Table.

(10) Orally describe the use of the Oxygen Partial Limits and Oxygen Depth Time Limits.

(11) Given the maximum depth/time limits for each component and the maximum partial pressure limits, state, in writing, the set point(s) in terms of the effects of operating above or below them.

ASSIGNMENT SHEET 2-1-4A

TITLE: Diving Physics (Phase I)

STUDY ASSIGNMENT

U.S. Navy Diving Manual, Vol. I, Chap. 2

STUDY QUESTIONS

1. Define the following terms applicable to diving physics:

   a. Kinetic energy

   b. Atmospheric Pressure

   c. Energy

   d. Nitrogen Narcosis

   e. Radiant energy

   f. Atoms

   g. Work

   h. Wet-bulb temperature

   i. Potential energy

   j. Matter

   k. Gage pressure

   l. Power

   m. Hydrostatic pressure

n. Turbidity

o. Molecules

p. Heat

q. Humidity

r. Convection

s. Atomic energy

t. Dewpoint

u. Element

v. Chemical energy

w. Hyperbaric

x. Specific heat

y. Pressure gradient

z. Absolute pressure

2. Define the differences between solids, liquids and gases.

3. What is the primary advantage of the metric system of measurement?

4. What are the four units of length used in the metric system? Which is the principle unit?

5. What are the units of weight associated with the metric system?

6. Convert the following:

   a. 73° Fahrenheit to celsius

   b. 16° celsius to fahrenheit

   c. 73° Fahrenheit to degrees Rankine

   d. 16° Celsius to degrees Kelvin

7. Under the sea, pressure is a result of two factors. What are they?

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8. What happens when outside pressure is applied to water?

9. Write Archimedes Principle.

10. Describe:

    a. Positive Buoyancy:

    b. Neutral Buoyancy:

    c. Negative Buoyancy:

11. At what approximate depth will a breath-holding diver reach a state of neutral buoyancy?

12. When would 100% Oxygen be used in diving operations?

13. Helium is almost totally inert. What does this mean?

14. What are the disadvantages of using Helium in diving operations?

15. Hydrogen is highly explosive when mixed with _____ in proportions that include a presence of more than _____ oxygen.

16. What are the two major concerns with Carbon Dioxide for divers?

17. What are the first symptoms of Carbon Monoxide Poisoning?

18. Write the Kinetic Theory of gases.

19. The General Gas Law is a combination of which two laws?

20. How does the mixing of gases within a container occur?

21. Describe partial pressure.

22. What is refraction? Why does it occur?

23. Sound travels faster in water than in air.

a. True
b. False

ASSIGNMENT SHEET 2-1-9A

TITLE: Diving Physics/Decompression Charting (PHASE II)

STUDY ASSIGNMENT

U.S.Navy Diving Manual, Volume I, Chapter 7

STUDY QUESTIONS

1. Complete the following statement: Variations in decompression procedures are permissible only _____ _____ _____ of a _____ _____ _____ _____ in _____ _____.

2. Define the following as they apply to decompression tables:

a. Bottom time -

b. Residual nitrogen

c. Repetitive dive

3. With the exception of the Surface Decompression Table using oxygen, the rate of ascent for all dives is _____ _____ _____. What is the rate of ascent according to the Surface Decompression Table using oxygen?

_____.

4. State the rules for selection of depth and bottom time for decompression schedules.

a.

ASSIGNMENT SHEET 2-1-10A

b.

5. What allowances should be made for divers working strenously?

6. When does time for a decompression stop begin?

7. Why should a Diving Officer fully justify the need for conducting an exceptional exposure dive?

8. What is meant by "equivalent single dive"?

9. Define surface decompression.

ASSIGNMENT SHEET 2-1-11A

10. In the following dives, circle those that are considered exceptional exposure dives.

a. 140 feet for 80 minutes
b. 180 feet for 60 minutes
c. 60 feet for 180 minutes
d. 240 feet for 10 minutes
e. 120 feet for 180 minutes
f. 70 feet for 10 minutes

11. For the dives below, provide the following information: Time to first stop, depth of first stop, time spent at first stop, total ascent time and repetitive group.

	Time to 1st Stop	Depth of 1st Stop	Time Spent at 1st Stop	Total Ascent Time	Repet. Group
a. 70 ft/130 min					
b. 130 ft/30 min					
c. 190 ft/10 min					
d. 180 ft/50 min					
e. 40 ft/210 min					

12. What is the Repetitive Dive Group Designation for the following no-decompression dives?

a. 10 ft for 210 minutes -
b. 80 ft for 20 minutes -
c. 120 ft for 12 minutes -
d. 190 ft for 5 minutes -

13. What would be the residual nitrogen time for the following cases?

a. Dive of 40 ft for 60 min. Surface interval of 8 minutes.
b. Dive of 180 ft for 20 min. Surface interval of 13 hours 23 minutes.

ASSIGNMENT SHEET 2-1-12A

14. A repetitive dive is to be made to 90 ft. for an estimated 10 minutes. He made a previous dive of 120 feet for 20 minutes. The surface interval time has been 4 hours and 15 minutes. What decompression schedule should be used for the repetitive dive?

15. What is the ascent rate used in the Surface Decompression Table using oxygen from 30 feet to the surface?

16. What are the advantages of using the Surface Decompression Table using oxygen?

17. What is the total allowable elapsed time from a diver reaching the surface on ascent to his first descent stop in the decompression chamber?

ASSIGNMENT SHEET 2-1-13A 172
TITLE: Diving Physics/Decompression Charting (Phase III)

STUDY ASSIGNMENT

U.S.Navy Diving Manual, Volume 1, Chapter 7

STUDY QUESTIONS

1. A dive was made to 230 feet with a TBT of 30 minutes. If the diver LS at 0930, what time should he surface? What would his TDT and TTD be?

2. Using a shedule of 140'/:70 Surface Decompression on Oxygen, what time does the diver reach his 40 feet Chamber stop? Compute TDT and TTD. LS at 1115.

3. Using a schedule of 180'/:30 Surface Decompression on Air, what time should the diver reach his first water stop if he LS at 1300? What time should he reach his first chamber stop? Compute his TDT and TTD.

4. Red diver left surface at 0947 on a dive to 133 feet. His TBT was :46. What time should he reach the surface? Determine his TDT and TTD. What is his Repetitive Group Letter?

5. The same diver from #4 makes a repetitive dive on air after a 1:03 surface interval. What is the equivalent single dive time? Depth of the repetitive dive is 142'. What is the correct decompression schedule if this is an air dive? TBT :27.

6. According to #4 and 5, above, what time should red diver leave the surface to start the repetitive dive? While attempting to leave the bottom, red diver was fouled for 3::18 at 142'. What should be done with this additional time? Compute the TDT and TTD for this repetitive dive.

7. A dive was made to 121' with a :53 bottom time, leaving the surface at 2341. After a 1 hour 49 minute surface interval, the same diver re-entered the water to a depth of 147' for 28 minutes. What time should he reach the surface from the repetitive dive if a Sur D O2 schedule was to recompress him for the repetitive dive? What is his TDT and TTD for the repetitive dive?

8. Leave the surface at 1642; depth of dive is 159' with a TBT of :28. What is the correct travel time to the first stop? What is the TDT and TTD?

9. The diver in #8 has a 2:28 surface interval before making a repetitive dive to 141' for :15. What is his residual nitrogen time from the previous dive? What time should he surface if decompression is surface decompression using air as the media? Compute his TDT and TTD.

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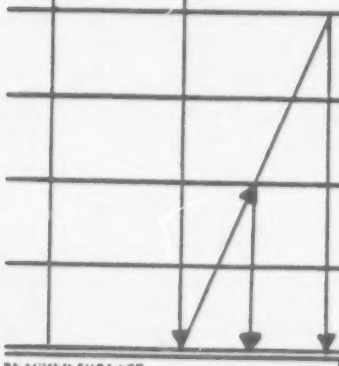
ASSIGNMENT SHEET 2-1-15A

DIVING CHART
MDW-DSDS-7 (REV. 4-69)

NAME OF DIVER	RATE	TABLE USED	DATE
NAME OF DIVER	RATE	TENDER (Sign name)	
PURPOSE OF DIVE		INSTRUCTOR	

LEFT SURFACE	REACHED BOTTOM	BOTTOM TIME	LEFT BOTTOM	TIME TO FIRST STOP	TOTAL BOTTOM TIME
DEPTH IN FEET	TOTAL DECOMPRESSION TIME		TOTAL TIME OF DIVE		PRESSURE IN POUNDS

DIVE RECORD	DEPTH OF STOP	LBS. PRESSURE	TIME
	130	58	REACHED / LEFT
	120	54	REACHED / LEFT
	110	49	REACHED / LEFT
	100	44.5	REACHED / LEFT
	90	40	REACHED / LEFT
	80	36	REACHED / LEFT
	70	32	REACHED / LEFT
	60	27	REACHED / LEFT
	50	22	REACHED / LEFT
	40	18	REACHED / LEFT
	30	13	REACHED / LEFT
	20	9	REACHED / LEFT
	10	4.5	REACHED / LEFT



REACHED SURFACE	DIVER'S CONDITION
NEW GROUP	REMARKS (Continue on reverse side if necessary)

L 1891

GPO 831-870

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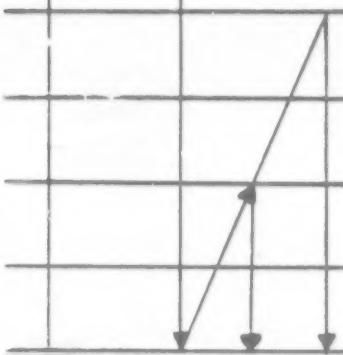
ASSIGNMENT SHEET 2-1-16A

DIVING CHART
NDW-DSDS-7 (REV 4-69)

NAME OF DIVER	RATE	TABLE USED	DATE
NAME OF DIVER	RATE	TENDER (Sign name)	
PURPOSE OF DIVE		INSTRUCTOR	

LEFT SURFACE	REACHED BOTTOM	INCIDENT TIME	LEFT BOTTOM	TIME TO FIRST STOP	TOTAL BOTTOM TIME
DEPTH IN FEET	TOTAL DECOMPRESSION TIME		TOTAL TIME OF DIVE		PRESSURE IN POUNDS

DIVE RECORD	DEPTH OF STOP	LBS. PRESSURE	TIME
	130	58	REACHED / LEFT
	120	54	REACHED / LEFT
	110	49	REACHED / LEFT
	100	44.5	REACHED / LEFT
	90	40	REACHED / LEFT
	80	36	REACHED / LEFT
	70	32	REACHED / LEFT
	60	27	REACHED / LEFT
	50	22	REACHED / LEFT
	40	18	REACHED / LEFT
	30	13	REACHED / LEFT
	20	9	REACHED / LEFT
	10	4.5	REACHED / LEFT



REACHED SURFACE	DIVER'S CONDITION
NEW GROUP	REMARKS (Continue on reverse side if necessary)

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GPO 831-679

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ASSIGNMENT SHEET 2-1-17A

DIVING CHART
NDW-DSDS-7 (REV. 4-69)

NAME OF DIVER	RATE	TABLE USED	DATE
NAME OF DIVER	RATE	TENDER (Sign name)	
PURPOSE OF DIVE		INSTRUCTOR	

LEFT SURFACE	REACHED BOTTOM	DIVE TIME	LEFT BOTTOM	TIME TO FIRST STOP	TOTAL BOTTOM TIME
DEPTH IN FEET	TOTAL DECOMPRESSION TIME		TOTAL TIME OF DIVE		PRESSURE IN POUNDS

DIVE RECORD	DEPTH OF STOP	LBS. PRESSURE	TIME
	130	58	REACHED / LEFT
	120	54	REACHED / LEFT
	110	49	REACHED / LEFT
	100	44.5	REACHED / LEFT
	90	40	REACHED / LEFT
	80	36	REACHED / LEFT
	70	32	REACHED / LEFT
	60	27	REACHED / LEFT
	50	22	REACHED / LEFT
	40	18	REACHED / LEFT
	30	13	REACHED / LEFT
	20	9	REACHED / LEFT
	10	4.5	REACHED / LEFT

REACHED SURFACE	DIVER'S CONDITION
NEW GROUP	REMARKS (Continue on reverse side if necessary)

GPO 691-870

ASSIGNMENT SHEET 2-1-18A

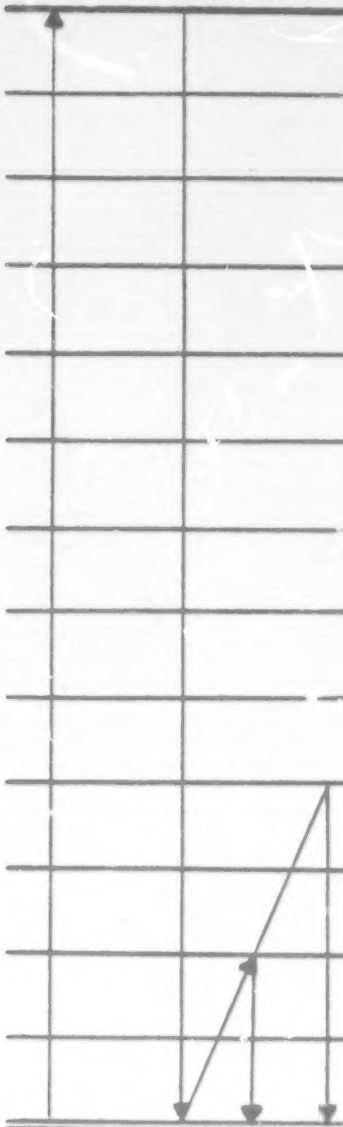
DIVING CHART
NDW-DSDS-7 (REV. 4-69)

NAME OF DIVER	RATE	TABLE USED	DATE
NAME OF DIVER	RATE	TENDER (Type name)	
PURPOSE OF DIVE		INSTRUCTOR	

LEFT SURFACE	REACHED BOTTOM	BOTTOM TIME	LEFT BOTTOM	TIME TO FIRST STOP	TOTAL BOTTOM TIME

DEPTH IN FEET	TOTAL DECOMPRESSION TIME	TOTAL TIME OF DIVE	PRESSURE IN POUNDS

DIVE RECORD	DEPTH OF STOP	LBS. PRESSURE	TIME
	130	58	REACHED LEFT
	120	54	REACHED LEFT
	110	49	REACHED LEFT
	100	44.5	REACHED LEFT
	90	40	REACHED LEFT
	80	36	REACHED LEFT
	70	32	REACHED LEFT
	60	27	REACHED LEFT
	50	22	REACHED LEFT
	40	18	REACHED LEFT
	30	13	REACHED LEFT
	20	9	REACHED LEFT
	10	4.5	REACHED LEFT



REACHED SURFACE	DIVER'S CONDITION
NEW GROUP	REMARKS (Continue on reverse side if necessary)

GPO 921-876

178

ASSIGNMENT SHEET 2-1-19A

REPETITIVE DIVE WORKSHEET

I. PREVIOUS DIVE:

___ minutes
___ feet
} see table 1-5 or 1-6 for repetitive group designation } Group___

II. SURFACE INTERVAL:

___hours___minutes on surface
Group___(from I.)
} see table 1-7 for new group } Group___

III. RESIDUAL NITROGEN TIME:

____ feet (depth of repetitive dive)
Group___(from II.)
} see table 1-8 } ___minutes

IV. EQUIVALENT SINGLE DIVE TIME:

___minutes (residual nitrogen time from III.)

(add) ___minutes (actual bottom time of repetitive dive)

(sum) ___minutes

V. DECOMPRESSION FOR REPETITIVE DIVE:

___minutes (equivalent single dive time from IV.)
____feet (depth of repetitive dive)
} see table 1-5 or 1-6 1-17 or 1-18

☐ No decompression required

or

Decompression stops: ____feet ____minutes
____feet ____minutes
____feet ____minutes
____feet ____minutes
____feet ____minutes

Table Used _____
Repet. Group _____

PRNC-0505 15

GPO 873-765

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ASSIGNMENT SHEET 2-1-20A

DIVING CHART
NDW-DSDS-7 (REV. 4-69)

NAME OF DIVER	RATE	TABLE USED	DATE
NAME OF TENDER	RATE	TENDER (Sign name)	
PURPOSE OF DIVE		INSTRUCTOR	

LEFT SURFACE	REACHED BOTTOM	INCIDENT TIME	LEFT BOTTOM	TIME TO FIRST STOP	TOTAL BOTTOM TIME

DEPTH IN FEET	TOTAL DECOMPRESSION TIME	TOTAL TIME OF DIVE	PRESSURE IN POUNDS

DIVE RECORD	DEPTH OF STOP	LBS. PRESSURE	TIME
	130	[illegible]	REACHED LEFT
	120	54	REACHED LEFT
	110	49	REACHED LEFT
	100	44.5	REACHED LEFT
	90	40	REACHED LEFT
	80	36	REACHED LEFT
	70	32	REACHED LEFT
	60	27	REACHED LEFT
	50	22	REACHED LEFT
	40	18	REACHED LEFT
	30	13	REACHED LEFT
	20	9	REACHED LEFT
	10	4.5	REACHED LEFT

REACHED SURFACE	DIVER'S CONDITION
NEW GROUP	REMARKS (Continue on reverse side if necessary)

GPO 831-076

180, ASSIGNMENT SHEET 2-1-21A

DIVING CHART
NDW-DSDS-7 (REV. 4-69)

NAME OF DIVER	RATE	TABLE USED	DATE	
NAME OF DIVER	RATE	TENDER (Sign name)		
PURPOSE OF DIVE		INSTRUCTOR		
LEFT SURFACE	REACHED BOTTOM	BOTTOM TIME	LEFT BOTTOM	TIME TO FIRST STOP	TOTAL BOTTOM TIME
DEPTH IN FEET	TOTAL DECOMPRESSION TIME		TOTAL TIME OF DIVE		PRESSURE IN POUNDS

DIVE RECORD	DEPTH OF STOP	LBS. PRESSURE	TIME
	130	58	REACHED / LEFT
	120	54	REACHED / LEFT
	110	49	REACHED / LEFT
	100	44.5	REACHED / LEFT
	90	40	REACHED / LEFT
	80	36	REACHED / LEFT
	70	32	REACHED / LEFT
	60	27	REACHED / LEFT
	50	22	REACHED / LEFT
	40	18	REACHED / LEFT
	30	13	REACHED / LEFT
	20	9	REACHED / LEFT
	10	4.5	REACHED / LEFT

REACHED SURFACE	DIVER'S CONDITION
NEW GROUP	REMARKS (Continue on reverse side if necessary)

GPO 891-678

REPETITIVE DIVE WORKSHEET

I. PREVIOUS DIVE:

___ minutes
____ feet
} see table 1-5 or 1-6 for repetitive group designation } Group___

II. SURFACE INTERVAL:

___hours___minutes on surface
Group___ (from I.)
} see table 1-7 for new group } Group___

III. RESIDUAL NITROGEN TIME:

____ feet (depth of repetitive dive)
Group___ (from II.)
} see table 1-8 } ___minutes

IV. EQUIVALENT SINGLE DIVE TIME:

___ minutes (residual nitrogen time from III.)

(add) ___ minutes (actual bottom time of repetitive dive)

(sum) ___ minutes

V. DECOMPRESSION FOR REPETITIVE DIVE:

___ minutes (equivalent single dive time from IV.)
____ feet (depth of repetitive dive)
} see table 1-5 or 1-6 1-17 or 1-18

☐ No decompression required

or

Decompression stops: ____ feet ____ minutes
____ feet ____ minutes
____ feet ____ minutes
___ feet ____ minutes
____ feet ____ minutes

Table Used _____
Repet. Group_____

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ASSIGNMENT SHEET 2-1-23A

DIVING CHART
NDW-DSDS-7 (REV. 4-49)

NAME OF DIVER	RATE	TABLE USED	DATE
NAME OF DIVER	RATE	TENDER (Sign name)	
PURPOSE OF DIVE		INSTRUCTOR	

LEFT SURFACE	REACHED BOTTOM	POINT TIME	LEFT BOTTOM	TIME TO FIRST STOP	TOTAL BOTTOM TIME

DEPTH IN FEET	TOTAL DECOMPRESSION TIME	TOTAL TIME OF DIVE	PRESSURE IN POUNDS

DIVE RECORD	DEPTH OF STOP	LBS. PRESSURE	TIME
	130	58	REACHED / LEFT
	120	54	REACHED / LEFT
	110	49	REACHED / LEFT
	100	44.5	REACHED / LEFT
	90	40	REACHED / LEFT
	80	36	REACHED / LEFT
	70	32	REACHED / LEFT
	60	27	REACHED / LEFT
	50	22	REACHED / LEFT
	40	18	REACHED / LEFT
	30	13	REACHED / LEFT
	20	9	REACHED / LEFT
	10	4.5	REACHED / LEFT

REACHED SURFACE	DIVER'S CONDITION
NEW GROUP	REMARKS (Continue on reverse side if necessary)

GPO 891-876

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ASSIGNMENT SHEET 2-1-24A

DIVING CHART
NDW-DSDS-7 (REV. 4-65)

NAME OF DIVER	RATE	TABLE USED	DATE		
NAME OF DIVER	RATE	TENDER (Sign name)			
PURPOSE OF DIVE		INSTRUCTOR			
LEFT SURFACE	REACHED BOTTOM	BOTTOM TIME	LEFT BOTTOM	TIME TO FIRST STOP	TOTAL BOTTOM TIME
DEPTH IN FEET	TOTAL DECOMPRESSION TIME		TOTAL TIME OF DIVE		PRESSURE IN POUNDS

DIVE RECORD	DEPTH OF STOP	LBS. PRESSURE	TIME
	130	58	REACHED / LEFT
	120	54	REACHED / LEFT
	110	49	REACHED / LEFT
	100	44.5	REACHED / LEFT
	90	40	REACHED / LEFT
	80	36	REACHED / LEFT
	70	32	REACHED / LEFT
	60	27	REACHED / LEFT
	50	22	REACHED / LEFT
	40	18	REACHED / LEFT
	30	13	REACHED / LEFT
	20	9	REACHED / LEFT
	10	4.5	REACHED / LEFT

REACHED SURFACE	DIVER'S CONDITION
NEW GROUP	REMARKS (Continue on reverse side if necessary)

GPO 891-676

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ASSIGNMENT SHEET 2-1-25A

REPETITIVE DIVE WORKSHEET

I. PREVIOUS DIVE:

___ minutes
____ feet
} see table 1-5 or 1-6 for repetitive group designation } Group___

II. SURFACE INTERVAL:

__hours__minutes on surface
Group___(from I.)
} see table 1-7 for new group } Group___

III. RESIDUAL NITROGEN TIME:

___feet (depth of repetitive dive)
Group___(from II.)
} see table 1-8 } ___minutes

IV. EQUIVALENT SINGLE DIVE TIME:

___minutes (residual nitrogen time from III.)

(add) ___minutes (actual bottom time of repetitive dive)

(sum) ___minutes

V. DECOMPRESSION FOR REPETITIVE DIVE:

___minutes (equivalent single dive time from IV.)
____.feet (depth of repetitive dive)
} see table 1-5 or 1-6 1-17 or 1-18

☐ No decompression required

or

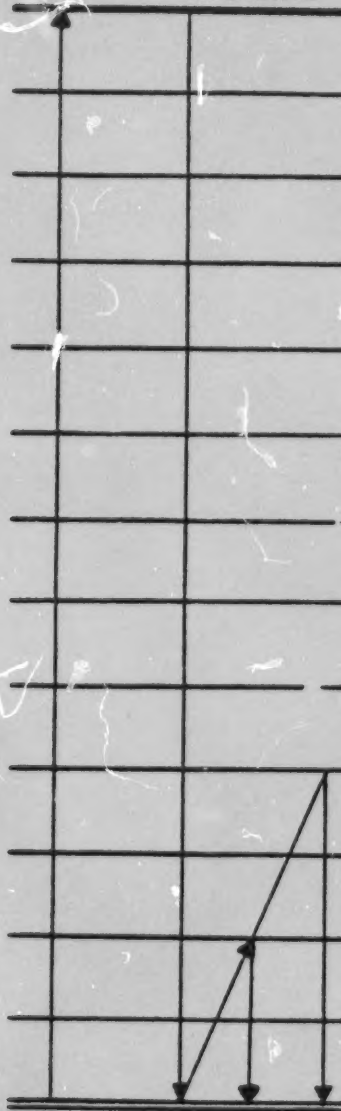
Decompression stops: ____feet ____minutes
____feet ____minutes
____feet ____minutes
__feet ____minutes
____feet ____minutes

Table Used _____
Repet. Group_____

ASSIGNMENT SHEET 2-1-26A

DIVING CHART
NDW-OSDS-7 (REV. 4-49)

NAME OF DIVER	RATE	TABLE USED	DATE		
NAME OF DIVER	RATE	TENDER (Sign name)			
PURPOSE OF DIVE		INSTRUCTOR			
LEFT SURFACE	REACHED BOTTOM	INCIDENT TIME	LEFT BOTTOM	TIME TO FIRST STOP	TOTAL BOTTOM TIME
DEPTH IN FEET	TOTAL DECOMPRESSION TIME		TOTAL TIME OF DIVE		PRESSURE IN POUNDS

DIVE RECORD	DEPTH OF STOP	LBS. PRESSURE	TIME
	130	58	REACHED LEFT
	120	54	REACHED LEFT
	110	49	REACHED LEFT
	100	44.5	REACHED LEFT
	90	40	REACHED LEFT
	80	36	REACHED LEFT
	70	32	REACHED LEFT
	60	27	REACHED LEFT
	50	22	REACHED LEFT
	40	18	REACHED LEFT
	30	13	REACHED LEFT
	20	9	REACHED LEFT
	10	4.5	REACHED LEFT

REACHED SURFACE	DIVER'S CONDITION
NEW GROUP	REMARKS (Continue on reverse side if necessary)

GPO 831-878

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ASSIGNMENT SHEET 2-2-1A

TITLE: Diving Formulas

LESSON TOPIC OBJECTIVES

Terminal Objective

1. When the student completes this course he will be able to, given a diving situation and a sheet containing formulas used in diving, select the applicable formula(s) and solve the problem posed in the situation.

Enabling Objective

1. Orally explain the meaning of all symbols used in diving formulas.
2. Orally explain the application and use of all diving formulas.
3. Describe, in writing, the sequence of computation for determining:

    a. The area of a square/rectangle.
    b. The area of a circle.
    c. The volume of a cube.
    d. The volume of a sphere.
    e. The volume of a cylinder.
    f. Lifting capacity in fresh water (in pounds).
    g. Lifting capacity in salt water (in pounds).
    h. Compressor Output.
    i. Over bottom pressure requirements.
    j. Cut off depth.
    k. Maximum oxygen percent.
    l. Effective atmosphere.
    m. Partial pressure of a gas (in psi).
    n. Volume left after falling (squeeze).
    o. Volume increase after blow up (embolism).
    p. Emergency Hose Test.

STUDY ASSIGNMENT

U.S.Navy Diving Manual, Volume 1, Appendix A

STUDY QUESTIONS

1. If a diver falls, which of the following falls would cause the greatest amount of injury?

    a. Surface to 33 feet.
    b. 33 feet to 99 feet.
    c. 66 feet to 165 feet.
    d. Volume lost is the same in each case

ASSIGNMENT SHEET 2-2-2A

STUDY QUESTIONS

2. What is the partial pressure of oxygen at 296'?

3. What would be the increase in volume in the divers' dress if he blows up from 221' to 164'?

4. What is the desired over-bottom pressure at 196'?

5. What is the lifting capacity of a sphere that is 30" in diameter and weighs 40 pounds?

6. What is the compressor out put required for three divers at 165'?

7. What is the gage pressure at 173'?

8. What is the <u>minimum</u> air supply required for a 157' dive?

9. What would be the emergency hose test for a planned dive not to exceed 131 feet?

10. What is the lifting capacity, in salt water, of a straight end pontoon having an overall length of 8", a diameter of 4'6" and weighs 336 pounds?

11. Convert 85° Fahrenheit to celsius (centigrade).

12. Convert the following:

a. 907.2 kilograms = _____ pounds = ___ tons(short)

b. 10 square chains = ___ acres = _____ square meters

c. 1 mile = 80 _____ = _____ kilometers = 1,760 _____

d. 1 kilowatt hour = _____ B.T.U. = _____ Joules

ASSIGNMENT SHEET 2-2-3A

e. 1.852 kilometers per hour = _____ feet per minute = _____ knots

f. 1 atmosphere = _____ feet (fresh water) = _____ feet (sea water) = 1.0133 _____

g. 3,088 foot-pounds per second = _____ kilowatts

h. 78.8° F = _____ C

13. What is the area of a circle with a radius of 5"?

14. What is the area of a rectangle 4 feet 6 inches long and 3 feet 10 inches wide?

NOTETAKING SHEET 2-i-1N

TITLE: Diving Physics

REFERENCES

U.S. Navy Diving Manual, Vol. 1

NOTETAKING OUTLINE

A. Basic Concept of Matter

1. Physics is the science of _____ and _____ and their _____.

2. _____ is the substance of which the _____ is composed.

3. _____ is the force which works upon and within the substance.

4. An _____ is the simplist form of matter which exhibits distinct _____ and _____ properties, and cannot be broken up into other, more basic forms, by _____ means.

5. The _____ is the smallest particle of matter which carries the specific properties of an _____.

6. _____ are formed from groups of atoms, and usually exhibit _____ _____ than any of the contributing atoms.

7. Three States of Matter

a. Solids: Have definite _____, _____ and _____.

b. Liquids: Have definite _____ and _____.

c. Gases: Has definite _____.

8. The state in which a particular substance exist depends upon:

a. _____

b. _____

B. Units of Measure

1. Metric System

a. Principle unit of length - _____

NOTETAKING SHEET 2-1-2N

1. One meter = _____ inches

2. 1000 meters = _____kilometer (about _____miles)

3. For measuring smaller lengths, _____(_____) or _____(_____) are used.

b. The metric system uses its units of _____ _____ to measure area.

1. One square meter = _____ ___ _____

c. Units of _____ are units of length _____

1. 1000 _____ centimeters = 1 liter (1000 cc)

2. 1 liter = _____ cubic meters.

d. The _____ is the standard metric unit of weight and _____. For smaller masses, the _____ and _____ are used.

1. 1000 gms = _____ _____ = _____ pounds

2. 1000 _____ = 1 gram

e. The most commonly used metric unit of pressure is _____ _____ _____ _____ (_____).

2. Fahrenheit and Celsius Temperatures

a. Countries that use the English measurement system generally employ the _____ scale.

1. Water boils at _____ and freezes at _____.

b. Countries that use the metric measurement system use the _____scale.

1. Water boils at _____ and freezes at _____.

c. Conversion to Temperature Scales

1. Fahrenheit to Celsius

$c = 5/9 (F - 32)$

a. Subtract _____ from the Fahrenheit reading.

b. Multiply the result by _____.

EXAMPLE:

2. Celsius to Fahrenheit
F = (9/5xC) + 32
a. Multiply _____ by Celsius reading.

b. Add _____ to the result.

EXAMPLE:

3. Heat energy is measured in _____ or _____.

a. BTU - _____ _____ _____ is the amount of heat needed to raise the temperature of _____ pound of water _____ degree fahrenheit.

4. Heat Transfer

a. _____ is the direct transmission of heat from _____ to _____, or through materials that are in direct contact with each other.

b. _____ is the transmission of heat by the movement of a _____ or a _____, as in an auto engine.

c. _____ is the transmission of heat by _____ _____ _____ of energy. Heat from the sun, electric heaters and fireplaces are examples.

C. Pressure in Diving

1. Key Points

a. Pressure is a _____ acting upon a particular area of _____. It is measured in pounds per _____ _____ in the metric system. (KG/cm2)

b. _____ is push or pull measured in pounds.

c. _____ is the surface that force is exerted upon.

d. Any diver, at any depth must be in _____ _____ with the forces at that depth.

e. Any consideration of pressure must always be thought of in terms of _____ and _____ pressure _____.

2. Types of Pressure

a. Atmospheric:

1. Considered to be _____ at sea level.

2. Acts on _____ things in _____ directions.

3. At sea level, weight is _____ psi or 1 _____.

b. Gage

1. Pressure exerted on any _____ object.

2. _____ at sea level.

3. Measured in _____.

c. Barometric

1. Essentially the same as _____ but varies with _____ conditions.

2. Expressed in terms of the weight of a column of _____ (standard pressure _____ ins. of mercury or _____ millimeters of mercury (mmhe).

d. Absolute

1. The _____ pressure being exerted, _____ plus one _____ _____.

2. Measured as _____ _____ _____ _____ absolute (psia).

D. Composition of Dry Air

1. Component	% by Volume
a. Nitrogen	_____

b. Oxygen _____

c. Carbon Dioxide _____

d. Rare Gases

1. Neon _____
2. Helium _____
3. Krypton _____
4. Hydrogen _____
5. Xenon _____
6. Radon _____
7. Carbon Monoxide _____

e. Commonly simplified as:

1. Nitrogen - _____%
2. Oxygen - _____%

2. Oxygen (O_2)

a. Colorless, _____ and tasteless.

b. Readily _____ with other elements

c. Only gas that can _____ _____

d. _____% minimum required to sustain life at _____ _____

e. Prolonged exposure to oxygen is _____

f. Supports _____, but does not _____

3. Nitrogen (N_2)

a. Colorless, odorless and _____

b. _____ _____ is a disorder resulting from the anesthetic properties of nitrogen breathed under _____.

NOTETAKING SHEET 2-1-6N

Can result in a loss of _____ and _____ by the diver.

4. Helium (He)

   a. Colorless, odorless and tasteless.

   b. Almost totally _____ and _____ in water.

   c. _____ times lighter than air.

   d. Used in diving to eliminate _____ _____ in deep diving operations.

   e. Disadvantages

      1. Voice _____ - Donald Duck effect

      2. High _____ conductivity

5. Hydrogen (H_2)

   a. Colorless, _____ and tasteless

   b. Rarely found in free state on _____, but abundant throughout the rest of the universe.

   c. _____ of all elements.

   d. Violently _____ is the prsence of more than _____ % oxygen.

   e. Hydrogen has been used in diving, but its hazards have limited its use to little more than experimentation.

6. Neon (Ne)

   a. Colorless, odorless and tasteless

   b. Good _____ of _____ at very low pressures.

   c. Has been used experimentally in diving.

7. Carbon Dioxide (CO_2)

   a. Colorless, odorless and tasteless in _____ percentages.

      Has an _____ taste and odor in greater concentrations.

   b. Natural by-product of _____

c. For divers, the two main concerns with CO_2 are:

1. Control of _____ in the breathing supply.

2. Removal of the _____ after breathing.

d. In high concentrations, CO_2 can be extremely _____.

8. Carbon Monoxide (CO)

a. Does not occur in _____ in the air.

b. Most commonly found in the exhaust of _____ _____ _____

c. Highly _____ to man

d. Colorless, odorless and tasteless

9. Water Vapor (H_2O)

a. _____ contains water vapor, which is considered a gas, and is responsible for _____ in the diver's air.

b. Problems with too much water vapor:

1. _____ faceplate

2. _____ air lines

3. _____ of body

c. Problems with too little water vapor

1. Irritated _____

2. Irritated _____

3. Dried out _____ in pumps and air lines.

E. Gas Laws

1. Kinetic Theory of Gases

a. The basic explaination of the behavior of gases under all variations of _____ and _____.

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NOTETAKING SHEET 2-1-8N

b. Two Related Factors

1. Molecular Speed - a _____ function

2. Gas _____ - Type gas function

3. A change in one of these factors must result in some _____ _____ in the other factor.

c. The kinetic energy of any gas at a given _____ is the same as the kinetic energy of any other _____ at the same _____. Consequently, the _____ of all gases resulting from kinetic energy are affected by the _____ _____.

2. Boyle's Law-_____/_____ relationship (P/V)

a. If the _____ remains constant, the _____ of a gas will vary inversely as the _____ _____ while the _____ will vary directly as the _____.

1. P1 V1 = P2 V2

P = _____, V = _____

1 = _____, 2 = _____

b. Deals with _____ and _____ _____

c. Pressure _____ - Volume _____ - squeeze results, if _____ is controlled.

d. Pressure _____ - Volume _____ - results in _____ _____ if ascent is uncontrolled.

e. Density _____ with pressure up to a point, at _____ _____, density increase slows, but generally, if the pressure on a gas is _____, the density is _____.

3. Charles' Law - _____/_____Relationship

a. If the pressure is kept constant, the _____ of a gas will vary directly as the _____ _____.

1. $\frac{V1}{T1} = \frac{V_2}{T_2}$

b. Deals with

1 _____ SCUBA

2 _____ and _____ breathing medias.

3. _____ _____ operations .

c. Volume _____ with _____ increase.

d. Volume _____ with temperature _____.

NOTE: It follows that if volume rather than pressure is kept constant, the absolute pressure will increase in propertion to the absolute temperature.

4. General Gas Law - Combination of _____ and _____ Laws.

a. With any gas, the factors of _____, _____ and _____ were so interrelated that a change in any of these factors must be balanced by a _____ change in one or both of the others.

5. Dalton's Law - _____ _____ Law.

a. The _____ pressure exerted by a _____ of gases is the sum of the pressure that would be exerted by _____ of the gases if it alone were present and occupied the _____ _____.

b. To illustrate, all cylinders are assumed to be of equal size.

1. 80/20 N2 02 Mix = _____% N2 _____% 02 = _____ _____.

2. At sea level (atmosphere _____)
0.8 ATM = _____ psi (N2)
0.2 ATM = _____ psi (02)
1.0 ATM = _____psi Total pressure exerted.

3. At 5 atmosphere absolute
4.0 ATM = _____ psi Total pressure exerted.

4. Total _____ pressure exerted by 02 at 5 ATM is approximately _____ to the air pressure at _____ _____.

NOTETAKING SHEET 2-1-10N

6. Henry's Law - _____ Law

   a. The amount of gas that will dissolve in a _____ at a given temperature is almost directly proportional to the _____ _____ of that gas.

   b. Three factors affect gas absorption by human tissues.

      1. _____ of dive.

      2. _____ of dive at depth.

      3. Condition of the _____ to supply and return _____ to and from the lungs.

   c. Gas _____ and dissolves in blood because of differences in partial pressures between _____ and _____ air.

7. Archimedes' Principle - Law of _____ and _____.

   a. Any object _____ or partially immersed in a liquid is _____ up by a force _____ to the weight of the liquid _____.

   b. Deals with:

      1. _____

      2. _____

      3. _____ capacities

      4. _____

   c. The laws of Floatation:

      1. A floating body displaces a _____ of liquid _____ to its own weight.

      2. A body _____ when the weight of the _____ displaced is _____ than the weight of the body.

      3. A submerged body remains in equilibrium when the _____ of the liquid displaced _____ the _____ _____ of the body.

      4. A submerged body will float when the body weighs _____ than the volume of the _____ _____.

NOTETAKING SHEET 2-1-11N

F. Energy in Diving

1. Effects of Light Rays in diving.

a. Intensity of light underwater altered by:

1. _____ reduction due to _____.

2. The _____ of light.

3. As the diver descends, the _____ of light decreases but not necessarily in regular amounts because of _____, _____ and _____ changes.

b. Color Absorption

1. _____ with depth.

2. _____ colors are absorbed out of the visible spectrum as the diver descends.

a. In clean water, _____ is removed first. _____ objects appear black.

b. _____ is next. Objects appear blue.

c. _____ and finally _____ are removed with progressively increasing depth.

c. Light Diffusion

1. Light rays are _____ and _____ in all directions.

2. Diffusion contributes to the _____ in total illumination, but at the same time tends to _____ vision by _____ the light evenly through the water at any given _____.

d. Light Refraction

1. Refraction causes _____ and _____ of objects underwater.

2. Distances appear _____ underwater due to refraction.

a. Objects appear _____ - _____ _____.

b. In turbid water, _____ dims, causing an apparent _____ in the distance, which becomes _____ the further away the object is.

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NOTETAKING SHEET 2-1-12N

2. Sound travels faster in _____ than in _____.

   a. The speed of sound in air is _____ feet per second.

   b. In water, sound travels _____ _____ as fast.

   c. Sound energy is greatly reduced when it passes from one _____ to _____.

      1. Divers cannot _____ to each other easily underwater.

   d. Appreciable amounts of _____ or _____ _____ air can alter vocal quality to produce a _____ _____ effect in diver's speech.

Application

I.

II.

III.

IV.

V.

NOTETAKING SHEET 2-1-13N

TITLE: Decompression Charting

REFERENCES

U.S. Navy Diving Manual , Vol. I

NOTETAKING OUTLINE

A. Air Decompression

1. Discussion:

Nitrogen absorption during a dive is directly related to the _____ _____ _____of the inspired _____, with particular emphasis on _____ and _____ duration. To prevent the development of _____ _____, special tables take into consideration the amount of nitrogen absorbed by the _____ _____ exceeds a certain critical amount. The diver's _____ must be delayed to allow the removal of excess nitrogen through normal _____ _____. Decompression sickness results from _____ ___ _____ the _____and to allow this process of gradual _____ to take place.

2. Definitions:

a. Single Dive - Any dive conducted after _____ _____ period of an previous dive.

b. Repetitive Dive - Any dive conducted within a _____ _____ period of a _____ dive.

c. Depth - When used to indicate the depth of a dive, means the _____ depth _____ _____ the dive. Measured in _____ ___ _____ _____.

d. Dive Schedule - Specific _____ procedure for a given combination of _____ and _____ _____,as listed in the decompression table. Normally indicated in _____ and _____.

e. Decompression Stop - Specified _____at which a diver must remain for a specified length of time to _____ _____ _____ from his body tissues.

f. Surface Interval - The time which a diver has spent on the _____ following a _____. Begins upon _____ and ending when he starts his _____.

g. Residual Nitrogen - Nitrogen gas, that is still _____ in a diver's tissues after he has _____.

NOTETAKING SHEET 2-1-14N

h. Repetitive Group Designator - a _____ which relates directly to the amount of _____ _____ in a diver's body for a _____ _____ period after a dive.

i. Residual Nitrogen Time - An amount of _____, in _____, which must be added to the _____ _____ of a repetitive dive to compensate for the _____ still in solution in a diver's tissues from a _____ dive.

j. Equivalent Single Dive Time - A single dive for which the _____ _____ is the sum of _____ _____ time and actual _____ time of the planned _____ dive.

k. Single Repetitive Dive - A dive for which the _____ _____ used to select the _____ _____ is the sum of the residual nitrogen time and the actual _____ _____ of the dive.

3. Diving Records Abbreviations

a. LS - _____
b. RB - _____
c. LB - _____
d. R - _____
e. L - _____
f. RS - _____
g. TBT - _____

1. Computed from _____ _____ to _____ _____

h. TDT - _____ _____

1. Computed from _____ the bottom to _____ the surface.

i. TTD - Total Time of Dive

1. Computed from leaving the surface to reaching the surface.

4. Table Selection

a. The following are decompression tables

1. _____ _____ _____ Decompression Tables

2. No Decompression Limits and Repetitive Group Designation Table.

3. Surface Decompression Table Using Oxygen

4. Surface Decompression Table Using Air.

b. Conditions for Selection

1. _____

2. _____ of the dive

3. Availability of a _____ _____

4. Availability of an _____ _____ _____ within the _____.

5. Specific _____ conditions

a. _____ state

b. _____ temperature

c. Residual Nitrogen Time Table for Repetitive Air Dives provides information relating to the _____ of repetitive dives.

d. Omitted Decompression - an _____ situation requiring _____ treatment.

e. Equipment

1. Use a diving _____ for all water decompression.

5. General Use of Decompression Tables

a. Rate of Descent

1. _____ feet per minute

2. Rounded off to next greater _____ _____.

b. Rate of Ascent

1. _____ feet per minute (except _____ _____ Table.

6. Variations in Rate of Ascent

a. Condition - Rate of ascent less than 60 FPM, delay occurs greater than _____ feet sea water.

1. Procedure - Increase _____ _____ by adding to it the total time of _____.

2. Decompress according to new _____ _____ _____.

b. Condition - Rate of ascent less than 60 FPM, delay occurs _____ than 50 Feet Sea Water.

1. Procedure - Increase the _____ stop by the amount of _____ _____.

c. Condition - Rate of ascent _____ than 60 FPM, No decompression required. Bottom time places diver within 10 minutes of decompression schedule requiring decompression.

1. Procedure - Stop at ____ ft. for the amount of _____ _____.

d. Condition - Rate of ascent _____ than 60 FPM, decompression required.

1. Procedure - Stop ____ ft. below _____ scheduled water stop for amount of _____ _____.

7. Oxygen Use During Decompression

a. Provides significant _____ in decompression time.

b. Oxygen partial pressure limits must not be _____ if symptoms of _____ _____ are to be avoided.

c. ____ work is performed by the diver when decompressing on oxygen.

8. Selection of Decompression Schedules

a. Given in ____ ____ depth increments.

b. Bottom times in _____ _____ increments.

c. _____ and _____ _____ _____ combined form actual dive.

d. Always select exact or _____ _____ depth.

e. Always select exact or _____ _____ time.

f. Do not _____ between decompression schedules.

g. Do not alter or modify a decompression schedule without prior approval of a _____ _____ _____.

h. Diver's _____ should be located as near as possible to the _____ depth.

j. Do not include _____ _____ as part of the stop time.

k. If the diver is extremely cold or showed signs of extreme fatigue during the dive, or if his work load was strenuous, the _____ _____ decompression schedule should be selected. This affects _____ _____ _____ only. Retain same _____ schedule.

9. Exceptional Exposure

a. Shown in _____ on the USN Standard Air Decompression Table.

b. To be used for exceptional or _____ cases only.

c. No _____ diving following decompression for exceptional exposure.

d. Use of exceptional exposure schedules requires the authorization of the _____ _____ .

10. Repetitive Dives

a. Any dive performed within ____ hours of a previous dive.

b. The period between dives is the surface interval:

1. ____ _____ maximum

2. _____ _____ minimum

c. Decompression requires special consideration due to the _____ _____ from the previous dive.

d. Refer to _____ _____ _____ assigned by either standard air table or not decompression table.

e. Determine residual nitrogen time by using _____ _____ _____ table.

f. Determine Equivalent Single Dive Time

1. Residual nitrogen time and total bottom time= _____ _____ _____ time.

g. _____ _____ is selected according to new equivalent single dive time.

h. Equivalent single dive times which require the use of exceptional exposure decompression schedules, shoud be _____.

i. If still another repetitive dive is to take place, the equivalent

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NOTETAKING SHEET 2-1-18N

single dive time from the _____ _____ _____ should be used to determine proper schedule selection.

11. Surface Decompression

a. Definition: _____
_____.

1. Desireable under the following conditions:

a. Extreme _____

b. Rough _____

c. Physical _____

b. Advantages

1. _____ _____ time in water.

2. _____ control

3. _____ observation

c. There is no surface decompression schedule for use following an _____ _____ dive.

d. No _____ _____ is allowed following surface decompression.

NOTETAKING SHEET 2-1-19N

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DIVING CHART
NDW-DSDS-7 (REV. 4-69)

NAME OF DIVER	RATE	TABLE USED	DATE
NAME OF DIVER	RATE	TENDER (Sign name)	
PURPOSE OF DIVE		INSTRUCTOR	

LEFT SURFACE	REACHED BOTTOM	INSTANT TIME	LEFT BOTTOM	TIME TO FIRST STOP	TOTAL BOTTOM TIME
DEPTH IN FEET	TOTAL DECOMPRESSION TIME		TOTAL TIME OF DIVE		PRESSURE IN POUNDS

DIVE RECORD	DEPTH OF STOP	LBS. PRESSURE	TIME
	130	58	REACHED / LEFT
	120	54	REACHED / LEFT
	110	49	REACHED / LEFT
	100	44.5	REACHED / LEFT
	90	40	REACHED / LEFT
	80	36	REACHED / LEFT
	70	32	REACHED / LEFT
	60	27	REACHED / LEFT
	50		REACHED / LEFT
	40	18	REACHED / LEFT
	30	13	REACHED / LEFT
	20	9	REACHED / LEFT
	10	4.5	REACHED / LEFT

REACHED SURFACE	DIVER'S CONDITION
NEW GROUP	REMARKS (Continue on reverse side if necessary)

GPO 991-678

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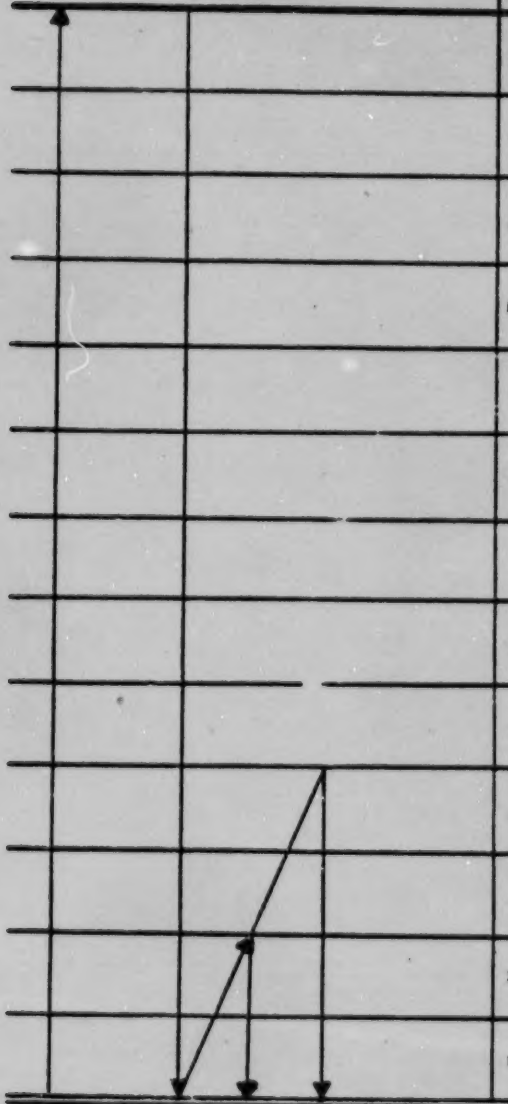
NOTETAKING SHEET 2-1-20N

DIVING CHART
NDW-DSDS-7 (REV. 4-69)

NAME OF DIVER	RATE	TABLE USED	DATE
NAME OF DIVER	RATE	TENDER (Sign name)	
PURPOSE OF DIVE		INSTRUCTOR	

LEFT SURFACE	REACHED BOTTOM	DESCENT TIME	LEFT BOTTOM	TIME TO FIRST STOP	TOTAL BOTTOM TIME
DEPTH IN FEET	TOTAL DECOMPRESSION TIME		TOTAL TIME OF DIVE		PRESSURE IN POUNDS

DIVE RECORD	DEPTH OF STOP	LBS. PRESSURE	TIME
	130	58	REACHED / LEFT
	120	54	REACHED / LEFT
	110	49	REACHED / LEFT
	100	44.5	REACHED / LEFT
	90	40	REACHED / LEFT
	80	36	REACHED / LEFT
	70	32	REACHED / LEFT
	60	27	REACHED / LEFT
	50	22	REACHED / LEFT
	40	18	REACHED / LEFT
	30	13	REACHED / LEFT
	20	9	REACHED / LEFT
	10	4.5	REACHED / LEFT

REACHED SURFACE	DIVER'S CONDITION
NEW GROUP	REMARKS (Continue on reverse side if necessary)

GPO 921-678

NOTETAKING SHEET 2-1-21N

DIVING CHART
NDW-OSDS-7 (REV. 4-69)

NAME OF DIVER	RATE	TABLE USED	DATE
NAME OF DIVER	RATE	TENDER (Sign name)	
PURPOSE OF DIVE		INSTRUCTOR	

LEFT SURFACE	REACHED BOTTOM	INCIDENT TIME	LEFT BOTTOM	TIME TO FIRST STOP	TOTAL BOTTOM TIME
DEPTH IN FEET	TOTAL DECOMPRESSION TIME		TOTAL TIME OF DIVE		PRESSURE IN POUNDS

DIVE RECORD	DEPTH OF STOP	LBS. PRESSURE	TIME
	130	58	REACHED / LEFT
	120	54	REACHED / LEFT
	110	49	REACHED / LEFT
	100	44.5	REACHED / LEFT
	90	40	REACHED / LEFT
	80	36	REACHED / LEFT
	70	32	REACHED / LEFT
	60	27	REACHED / LEFT
	50	22	REACHED / LEFT
	40	18	REACHED / LEFT
	30	13	REACHED / LEFT
	20	9	REACHED / LEFT
	10	4.5	REACHED / LEFT

REACHED SURFACE	DIVER'S CONDITION
NEW GROUP	REMARKS (Continue on reverse side if necessary)

GPO 891-676

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NOTETAKING SHEET 2-1-22N

DIVING CHART
NDW-DSDS-7 (REV. 4-69)

NAME OF DIVER	RATE	TABLE USED	DATE		
NAME OF TENDER	RATE	TENDER (Sign name)			
PURPOSE OF DIVE		INSTRUCTOR			
LEFT SURFACE	REACHED BOTTOM	DESCENT TIME	LEFT BOTTOM	TIME TO FIRST STOP	TOTAL BOTTOM TIME
DEPTH IN FEET	TOTAL DECOMPRESSION TIME		TOTAL TIME OF DIVE		PRESSURE IN POUNDS

DIVE RECORD	DEPTH OF STOP	LBS. PRESSURE	TIME
	130	58	REACHED / LEFT
	120	54	REACHED / LEFT
	110	49	REACHED / LEFT
	100	44.5	REACHED / LEFT
	90	40	REACHED / LEFT
	80	36	REACHED / LEFT
	70	32	REACHED / LEFT
	60	27	REACHED / LEFT
	50	22	REACHED / LEFT
	40	18	REACHED / LEFT
	30	13	REACHED / LEFT
	20	9	REACHED / LEFT
	10	4.5	REACHED / LEFT

REACHED SURFACE	DIVER'S CONDITION
NEW GROUP	REMARKS (Continue on reverse side if necessary)

GPO 871-676

NOTETAKING SHEET 2-1-23N

DIVING CHART
NDW-DSDS-7 (REV. 4-69)

NAME OF DIVER	RATE	TABLE USED	DATE
NAME OF TENDER	RATE	TENDER (Sign name)	
PURPOSE OF DIVE		INSTRUCTOR	

LEFT SURFACE	REACHED BOTTOM	POINT TIME	LEFT BOTTOM	TIME TO FIRST STOP	TOTAL BOTTOM TIME

DEPTH IN FEET	TOTAL DECOMPRESSION TIME	TOTAL TIME OF DIVE	PRESSURE IN POUNDS

DIVE RECORD	DEPTH OF STOP	LBS. PRESSURE	TIME
	130	58	REACHED / LEFT
	120	54	REACHED / LEFT
	110	49	REACHED / LEFT
	100	44.5	REACHED / LEFT
	90	40	REACHED / LEFT
	80	36	REACHED / LEFT
	70	32	REACHED / LEFT
	60	27	REACHED / LEFT
	50	22	REACHED / LEFT
	40	18	REACHED / LEFT
	30	13	REACHED / LEFT
	20	9	REACHED / LEFT
		4.5	REACHED / LEFT

REACHED SURFACE	DIVER'S CONDITION
NEW GROUP	REMARKS (Continue on reverse side if necessary)

GPO 891-679

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NOTETAKING SHEET 2-1-24N

DIVING CHART
NDW-DSDS-7 (REV. 4-69)

NAME OF DIVER	RATE	TABLE USED	DATE
NAME OF TENDER	RATE	TENDER (Sign name)	
PURPOSE OF DIVE		INSTRUCTOR	

LEFT SURFACE	REACHED BOTTOM	INCIDENT TIME	LEFT BOTTOM	TIME TO FIRST STOP	TOTAL BOTTOM TIME
DEPTH IN FEET	TOTAL DECOMPRESSION TIME		TOTAL TIME OF DIVE		PRESSURE IN POUNDS

DIVE RECORD	DEPTH OF STOP	LBS. PRESSURE	TIME
	130	58	REACHED / LEFT
	120	54	REACHED / LEFT
	110	49	REACHED / LEFT
	100	44.5	REACHED / LEFT
	90	40	REACHED / LEFT
	80	36	REACHED / LEFT
	70	32	REACHED / LEFT
	60	27	REACHED / LEFT
	50	22	REACHED / LEFT
	40	18	REACHED / LEFT
	30	13	REACHED / LEFT
	20	9	REACHED / LEFT
	10	4.5	REACHED / LEFT

REACHED SURFACE	DIVER'S CONDITION
NEW GROUP	REMARKS (Continue on reverse side if necessary)

GPO 691-676

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REPETITIVE DIVE WORKSHEET

I. PREVIOUS DIVE:

___ minutes
____ feet
} see table 1-5 or 1-6 for repetitive group designation } Group___

II. SURFACE INTERVAL:

___hours___minutes on surface
Group___ (from I.)
} see table 1-7 for new group } Group___

III. RESIDUAL NITROGEN TIME:

____ feet (depth of repetitive dive)
Group___ (from II.)
} see table 1-8 } ___minutes

IV. EQUIVALENT SINGLE DIVE TIME:

___ minutes (residual nitrogen time from III.)

(add) ___ minutes (actual bottom time of repetitive dive)

(sum) ___ minutes

V. DECOMPRESSION FOR REPETITIVE DIVE:

___ minutes (equivalent single dive time from IV.)
____ feet (depth of repetitive dive)
} see table 1-5 or 1-6 1-17 or 1-18

☐ No decompression required

or

Decompression stops: ____ feet ____ minutes
____ feet ____ minutes
____ feet ____ minutes
___ feet ____ minutes
____ feet ____ minutes

Table Used _____
Repet. Group_____

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NOTETAKING SHEET 2-1-26N

REPETITIVE DIVE WORKSHEET

I. PREVIOUS DIVE:

___ minutes
____ feet
} see table 1-5 or 1-6 for repetitive group designation } Group___

II. SURFACE INTERVAL:

___hours___minutes on surface
Group___ (from I.)
} see table 1-7 for new group } Group___

III. RESIDUAL NITROGEN TIME:

____ feet (depth of repetitive dive)
Group___ (from II.)
} see table 1-8 ___minutes

IV. EQUIVALENT SINGLE DIVE TIME:

___ minutes (residual nitrogen time from III.)

(add) ___ minutes (actual bottom time of repetitive dive)

(sum) ___ minutes

V. DECOMPRESSION FOR REPETITIVE DIVE:

___ minutes (equivalent single dive time from IV.)
____ feet (depth of repetitive dive)
} see table 1-5 or 1-6 1-17 or 1-18

☐ No decompression required

or

Decompression stops: ____ feet ____ minutes
____ feet ____ minutes
____ feet ____ minutes
___ feet ____ minutes
____ feet ____ minutes

Table Used _____
Repet. Group _____

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GPO 873-789

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REPETITIVE DIVE WORKSHEET

I. PREVIOUS DIVE:

___ minutes
____ feet
} see table 1-5 or 1-6 for repetitive group designation } Group___

II. SURFACE INTERVAL:

___hours___minutes on surface
Group___ (from I.)
} see table 1-7 for new group } Group___

III. RESIDUAL NITROGEN TIME:

____ feet (depth of repetitive dive)
Group___ (from II.)
} see table 1-8 } ___minutes

IV. EQUIVALENT SINGLE DIVE TIME:

___ minutes (residual nitrogen time from III.)

(add) ___ minutes (actual bottom time of repetitive dive)

(sum) ___ minutes

V. DECOMPRESSION FOR REPETITIVE DIVE:

___ minutes (equivalent single dive time from IV.)
____ feet (depth of repetitive dive)
} see table 1-5 or 1-6 1-17 or 1-18

☐ No decompression required

or

Decompression stops: ____ feet ___ minutes
____ feet ___ minutes
____ feet ___ minutes
___ feet ___ minutes
____ feet ___ minutes

Table Used _____
Repet. Group _____

REPETITIVE DIVE WORKSHEET

I. PREVIOUS DIVE:

___minutes
____feet
} see table 1-5 or 1-6 for repetitive group designation } Group___

II. SURFACE INTERVAL:

___hours___minutes on surface
Group___(from I.)
} see table 1-7 for new group } Group___

III. RESIDUAL NITROGEN TIME:

____feet (depth of repetitive dive)
Group___(from II.)
} see table 1-8 } ___minutes

IV. EQUIVALENT SINGLE DIVE TIME:

___minutes (residual nitrogen time from III.)

(add)___minutes (actual bottom time of repetitive dive)

(sum)___minutes

V. DECOMPRESSION FOR REPETITIVE DIVE:

___minutes (equivalent single dive time from IV.)
____feet (depth of repetitive dive)
} see table 1-5 or 1-6 1-17 or 1-18

☐ No decompression required

or

Decompression stops: ____feet ____minutes
____feet ____minutes
____feet ____minutes
____feet ____minutes
____feet ____minutes

Table Used _____
Repet. Group_____

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REPETITIVE DIVE WORKSHEET

I. PREVIOUS DIVE:

___ minutes
____ feet
} see table 1-5 or 1-6 for repetitive group designation } Group___

II. SURFACE INTERVAL:

___hours___minutes on surface
Group___(from I.)
} see table 1-7 for new group } Group___

III. RESIDUAL NITROGEN TIME:

____ feet (depth of repetitive dive)
Group___(from II.)
} see table 1-8 } ___minutes

IV. EQUIVALENT SINGLE DIVE TIME:

___minutes (residual nitrogen time from III.)

(add) ___minutes (actual bottom time of repetitive dive)

(sum) ___minutes

V. DECOMPRESSION FOR REPETITIVE DIVE:

___minutes (equivalent single dive time from IV.)
____feet (depth of repetitive dive)
} see table 1-5 or 1-6 1-17 or 1-18

☐ No decompression required

or

Decompression stops: ____feet ____minutes
____feet ____minutes
____feet ____minutes
___feet ____minutes
____feet ____minutes

Table Used _____
Repet. Group_____

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NOTETAKING SHEET 2-2-1N

FORMULAS FOR ALL UNITS

SYMBOLS AND NOTES USED IN THE FOLLOWING FORMULAS:

1. A = Area
2. C = Circumference
3. Ce = Celsius
4. D = Depth
5. F = Fahrenheit
6. H = Height
7. L = Length
8. N = Number of divers
9. R = Radius
10. T = Tons
11. Dia = Diameter
12. Dia^2 = Diameter squared
13. Dia^3 = Diameter Cubed
14. (pi) = 3.1416
15. 1/4 = .7854
16. 1/6 = .5236
17. P.P. = Partial Pressure
18. psi = pressure per square inch
19. psig = gauge pressure
20. psia = absolute pressure
21. FPM = Feet Per Minute
22. B.S. = Breaking Strain
23. S.W. = Safe Working Load

NOTES:

1. Always compute in feet or pounds.
2. One atmosphere = 14.7 psi or 33 feet of sea water.
3. One foot of sea water exerts .445 psig.
4. One cubic foot of fresh water displaces 62.4 pounds.
5. One cubic foot of salt water displaces 64 pounds.
6. 6.0 cubic feet of air per minute absolute required for diver breathing and ventilation requirements.

FORMULAS FOR AREA

1. Square or Rectangle: $A = L \times W$
2. Circle: $A = 1/4 \times Dia^2$, or $A = R^2$

FORMULAS FOR VOLUMES

1. Cube (compartment) $V = L \times W \times H$
2. Sphere (balloon) $V = (1/6\ ) \times D^3$
3. Cylinder (pontoon) $V = (1/4\ ) \times Dia^2 \times L$
4. Round End Pontoon $V = (1/6 \times Dia^3) + [1/4\ \times Dia^2 \times (L - D)]$

LIFTING CAPACITY (IN POUNDS)

1. Fresh Water: (V X 62.4) - Weight of the Lifting Unit
2. Salt Water: (V X 64) - Weight of the Lifting Unit

TEMPERATURES

1. Fahrenheit $F = (9/5C) + 32$
2. Celsius $C = 5/9\ (F - 32)$
3. Rankine $F° + 460°$
4. Kelvin $C° + 273°$

NOTETAKING SHEET 2-2-2N

FORMULAS FOR AIR REQUIREMENTS

1. Compressor Output (minimum) = $\left(\frac{D}{33} + 1\right) \times 6.0 \times N$
2. Over-bottom Pressure Requirements = 25 + .71D (Deep Sea System)
   50 + D (Mark 1 System)
   Maintain 50 psi (Jack Browne)
3. Depth, if CFM is known = $\frac{CFM}{6.0 \times N} - 1 \times 33$
4. Number of divers on given CFM = $\frac{CFM}{ATA \times 6.0}$

FORMULAS FOR HeO_2

1. Partial Pressure Table PPT = $(D + 33) \times [1.00 - (O_2\% - .02)]$
2. Cut-off Depth for O_2 = $\frac{O_2 \text{ Limiting Factor} \times 33}{O_2\%} - 33$
3. Maximum O_2 = $\frac{O_2 \text{ Limiting Factor} \times 33}{D + 33}$
4. Effective Atmosphere = $\frac{D + 33}{33} \times O_2\%$

MISCELLANEOUS FORMULAS

1. Partial Pressure of a gas (P.P.) = $[(D + 33) \times .445] \times \%$ of gas
2. Time between stops in seconds (T) = $\frac{(D \text{ left} - D \text{ arrived}) \times 60}{FPM}$
3. Volume of Decrease (squeeze)
   Volume of Air Remaining
   Volume of Increase (Gas Embolism)
   $V = \frac{D \text{ left} + 33}{D \text{ arrived} + 33} \times 100$
4. Emergency Hose Test = $[(D + 33) \times .445 + 50] \times 2$ (Hold pressure for 10 minutes)

FORMULAS FOR SEAMANSHIP

1. Breaking Strain of Natural Fiber Line = $C^2 \times 900$ lbs
2. Breaking Strain of Nylon Line = $C^2 \times 900 \times 2.5$
3. Breaking Strain of Wire = $C^2 \times 8{,}000$ lbs
4. Safe Working Load for 1 and 3 above:
   A. 1/5 B.S. = S.W. for new line and wire
   B. 1/10 B.S. = S.W. for average line or wire
   C. 1/15 B.S. = S.W. for old or worst line or wire
5. Safe Working Load for 2, above (Nylon)
   A. 1/3 B.S. = S.W. for new line
   B. 1/4 B.S. = S.W. for average line
   C. 1/6 B.S. = S.W. for old or worst line
6. Safe Working Load for a shackle = $3 \times Dia^2$ = S.W. in tons
7. Safe Working Load for a hook = $2/3 \times Dia^2$ = S.W. in tons

FOR OFFICIAL USE ONLY

STUDENT GUIDE

FOR

DIVER, SECOND CLASS (A-433-0022)

MEDICAL DEEP SEA DIVING TECHNICIAN (A-433-0020)

SHIP SALVAGE DIVING OFFICER (A-4N-0011)

DEEP SEA (HeO2) DIVING OFFICER (A-4N-0010)

VOLUME C

Underwater Basic

PREPARED BY

NAVAL SCHOOL DIVING AND SALVAGE

PREPARED FOR

SERVSCOLCOM,SDIEGO

SUBTRACENPAC,PHARBOR

NAVSCOLDIVSAL,WASH

31 OCTOBER 1975

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INFORMATION SHEET 6-1-1I

TITLE: Mk V Deep Sea Diving System (Underwater Basic)

INTRODUCTION

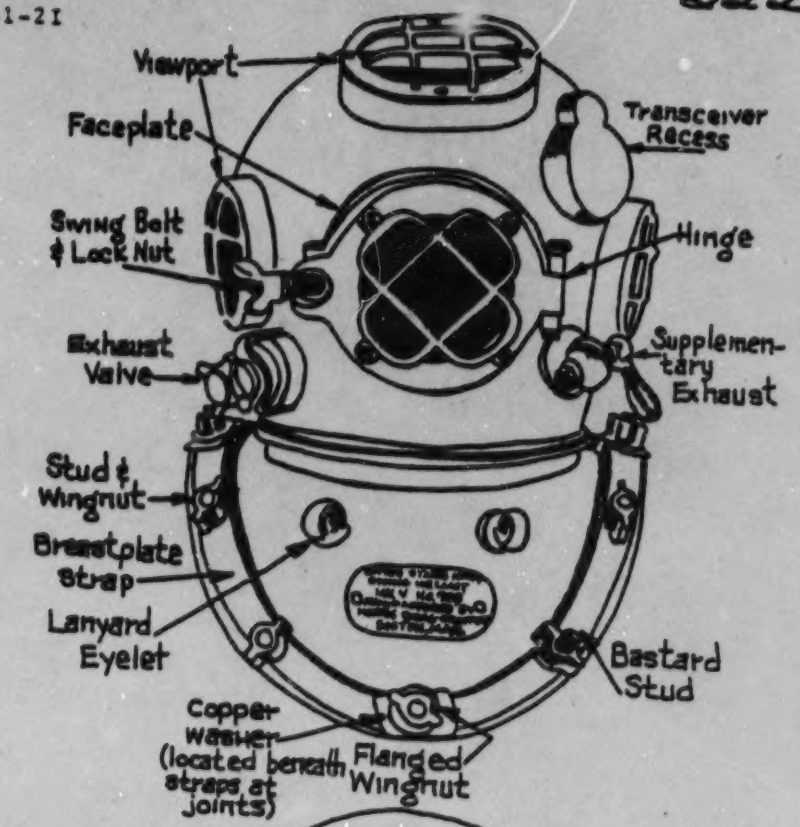
In your second phase of equipment training, the major components are broken down into their individual component parts so that you can better understand the operation of the entire system as well as being able to make repairs/replacements properly.

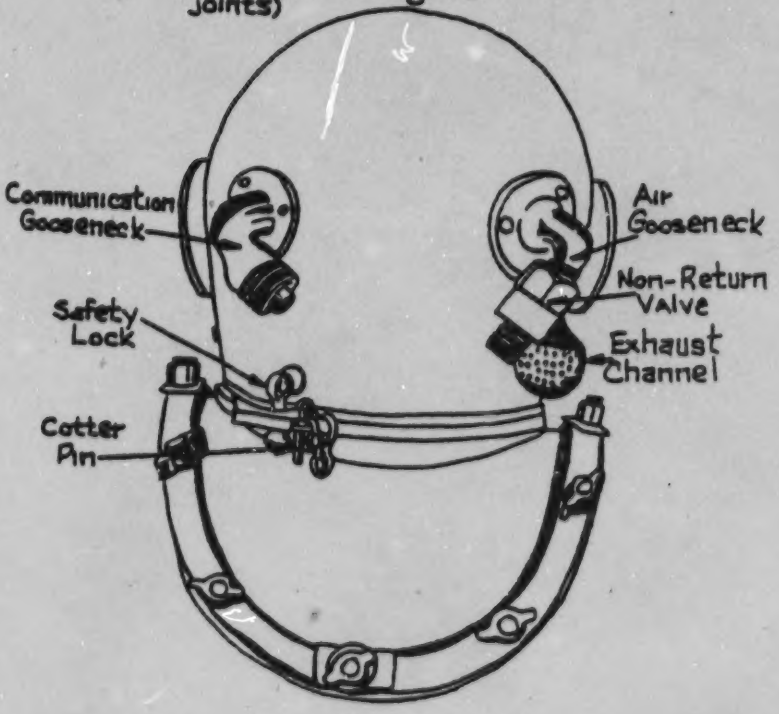
This information sheet contains detailed drawings of the major components and their component parts. Any items not understood should be directed to the instructor.

REFERENCES

U.S.Navy Diving Manual, Volume 1

MK V DEEP SEA DIVING SYSTEM HELMET





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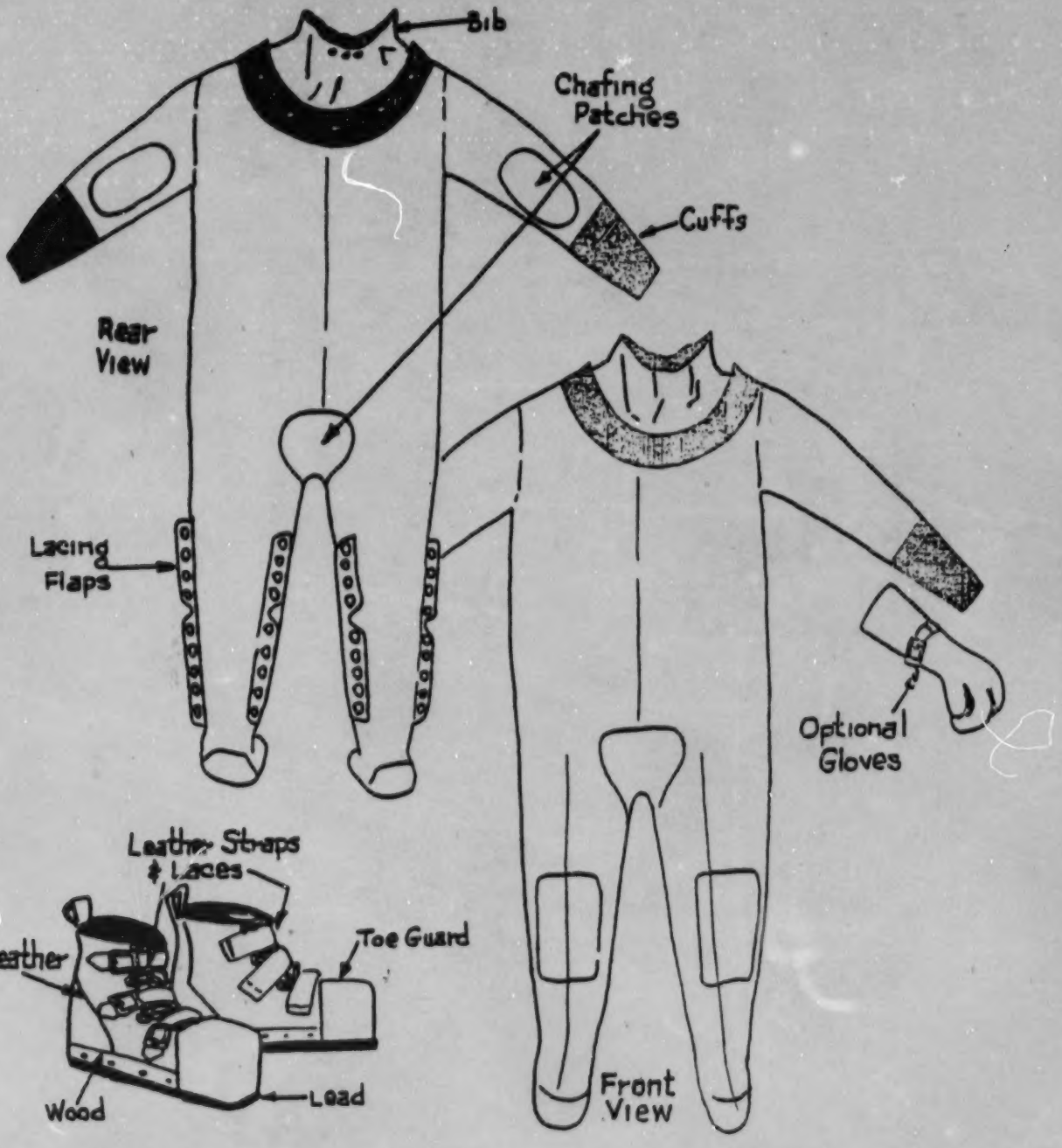
MK V DIVING DRESS & SHOES



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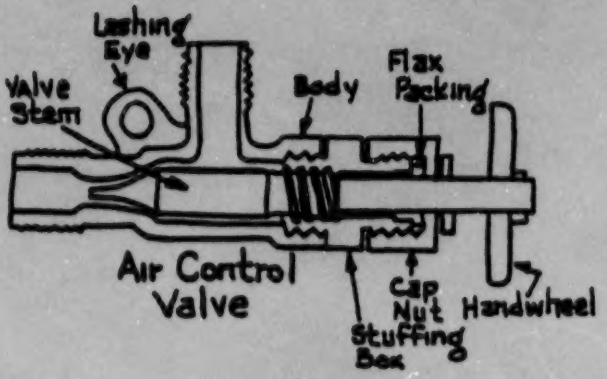
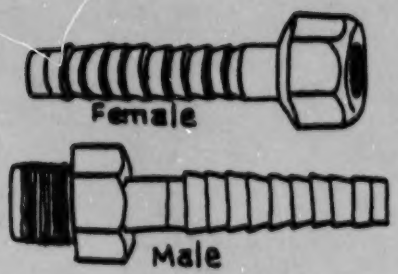
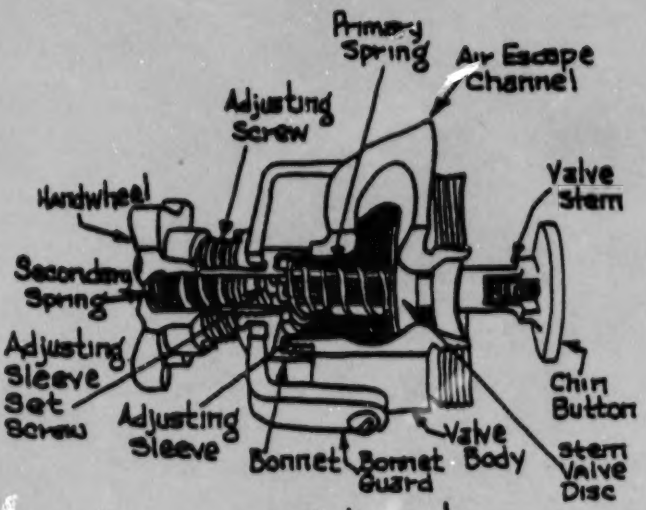
MKV SYSTEM COMPONENT PARTS

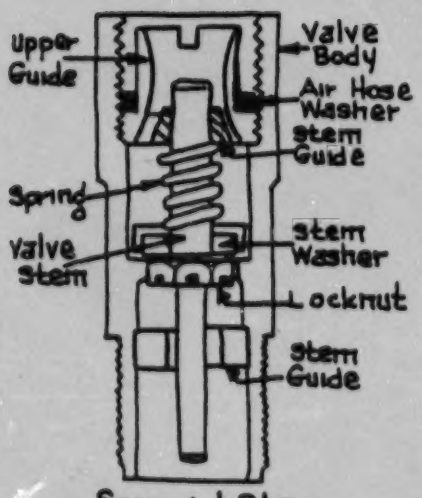




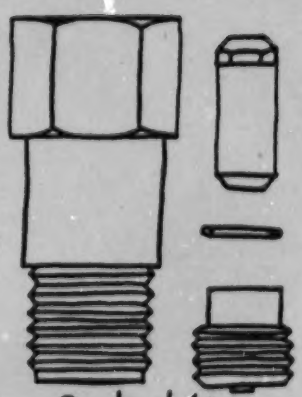
Air Hose Fittings



Exhaust Valve



Spring & Stem



Cartridge

Non-Return Valves

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ASSIGNMENT SHEET 6-1-1A

TITLE: Mk V Deep Sea Diving System (Underwater Basic)

LESSON TOPIC OBJECTIVES

Terminal Objectives

1. When the student completes this course he will be able to, given a list of the Mk V Deep Sea Diving System component parts, demonstrate a knowledge of the function of each, by matching the component part with it's functional description.

Enabling Objectives

1. Explain, in writing, the function(s) of the component parts of the Mk V Deep Sea Diving System in terms of what they do for the system.
2. Describe, by illustrating, the functional and physical location of the component parts within the major components.
3. Explain, in writing, how the component parts carry out their function(s).
4. Orally describe the major materials used to construct selected component parts and explain why the particular material is used.

STUDY ASSIGNMENT

U.S.Navy Diving Manual, Volume I, Reread Paragraph 6.1.1, Figure 6-45 and answer the following:

STUDY QUESTIONS

1. All viewports, including the faceplate, are protected by

_____ _____.

2. What is the function of the air channel?

3. Breastplate Straps are serialized. Why?

4. Describe the construction of the diving dress.

5. What is the function of the bib?

6. A set of Flaps and Lacings are along the rear of each leg of the diving dress. What is their function?

7. According to the manual, it is not necessary to wear diving underwear when using the Mk V Deep Sea Diving System in 78° water.

a. True b. False

8. What is the disadvantage of wearing the helmet cushion?

9. The weight belt weighs approximately _____ pounds.

10. The 50 feet of hose closest the helmet is covered with canvas. What is the proper name of this covering and why is it used?

11. The air hose is tested to supply air at a maximum working pressure of _____ psig.

12. What is the standardized diver's air hose thread?

13. The life line/amplifier cable has a _____-_____ steel cable core which provides a tensile strength of

_____ pounds.

14. If two lengths of life line/amplifier cable are joined, the overall strength is a static load of 1000 pounds. Why?

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ASSIGNMENT SHEET 6-2-1A
TITLE: Mk V Deep Sea Diving System Diver (Underwater Basic)

LESSON TOPIC OBJECTIVES

Terminal Objectives
1. When the student completes this course he will be able to, as a diver using the Mk V Deep Sea Diving System, in open water at a depth of at least twenty feet:

a. Demonstrate all searching line-pull signals and proper response to tender's searching line-pull signals during the execution of the Searching Project in accordance with Diving Training Standards.
b. Demonstrate a proficiency in the use of the Mk V Deep Sea Diving System by successfully completing, in accordance with Diving Training Standards, any two of the following projects: Single Flange, Seventeen Stud Pontoon, or Tooker Patch.
c. Use proper voice and line-pull communications during all training dives.

Enabling Objectives
1. List, in writing, all searching line-pull signals and explain the use of each.
2. Using a short line between two persons, demonstrate all searching line-pull signals.
3. Using a short line between two persons, demonstrate the correct response (movement) to the tender's searching line-pull signals.
4. Orally explain the Searching, Single Flange, Seventeen Stud Pontoon and Tooker Patch Projects in accordance with Diving Training Standards.
5. Orally describe operation and communication procedures for use on the Mk V Deep Sea Diving System during normal operations (i.e. monitoring the dive, underwater cutting and welding, and monitoring the pneumofathometer).
6. Orally describe operation and communication procedures for use on the Mk V Deep Sea Diving System during abnormal situations (i.e. loss of power, loss of communications, loss of guage readings).

STUDY ASSIGNMENT

U.S.Navy Diving Manual, Volume I, Paragraph 6.4.5, 6.4.6, 6.4.7, 6.4.9, 8.5.1.2, and 8.5.1.3

STUDY QUESTIONS

1. Upon reaching the bottom, and before leaving the area of the stage or descending line, the diver should _____ to _____ _____ _____ and to make certain that his _____ _____ is _____.

ASSIGNMENT SHEET 6-2-2A

2. If obstructions are encountered on the bottom, the diver should:

a. Go around them
b. Go over them
c. Go under them
d. None of the above

3. The Air Control Valve should never be fully closed except:

a.

b.

4. What is the primary hazard with mud bottoms?

5. When would a diver act as tender?

a.

b.

6. Never cut a line unless:

7. What are the rules governing the placement and removal of power tools at the diving job site?

8. What is the diver's first action when he discovers his lines are fouled?

9. There is enough air in the Mk V helmet to support _____ to _____ minutes of breathing.

10. Whis is more dangerous, falling in shallow water or deep water? Why?

ASSIGNMENT SHEET 6-2-3A

11. When a diver finds himself in trouble underwater, he should:

    a.
    b.
    c.
    d.

12. What can the diver do to counteract the effects of a blow-up?

    a.

    b.

    c.

13. Define the following Searching Line-pull signals:

    a. 4 Pulls -

    b. 2 Pulls-

    c. 7 Pulls-

    d. 1 Pull-

    e. 3 Pulls-

JOB SHEET 6-2-1J

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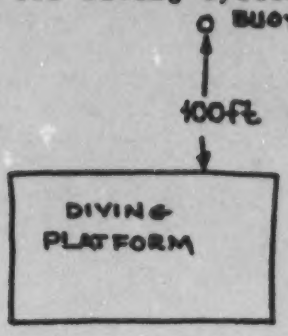
TITLE: Mk V Deep Sea Diving System Diver Searching Project



INTRODUCTION

This project is important for three reasons. First, this will be your first experience in open water using the Mk V Deep Sea Diving System will all the inherent dangers of open water - visibility (lack of it), bottom conditions, etc. Secondly, this project requires more movement by the diver than almost any other project in your training. It's difficult to move around in the Mk V - especially on a muddy bottom. What it takes is buoyancy control so you can "tip-toe" along the bottom. Not too light that you have trouble staying one the bottom, nor too heavy that you're sinking. Just right. Proper control may take practice, but it will come. Finally, this will be the first dive you'll be completing searching activities and using searching line-pull signals.

REFERENCES

U.S.Navy Diving Manual, Volume I
Diving Training Standards

EQUIPMENT AND MATERIAL

Diving Underwear, Diving Socks, Mk V Deep Sea Diving System and Searching Project Material.

JOB STEPS

1. Diver uses correct line-pull signals/voice communications and descends to the bottom (at least 20 feet) via ladder and descent line. At ladder, before going to descent line, diver will st[illegible] to close Supplementary Exhaust.

2. Diver reports he is on the bottom via line-pull signals and voice communications.

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JOB SHEET 6-2-2J

3. Diver responds to tender's searching line-pull signals by:

a. duplicating the signals received and,
b. moving in the direction indicated or stopping, as applicable to the line-pull signal received.

4. Object of the search is for the diver to find the portable buoy line and, pulling it, submerge the buoy two times.

5. After locating the buoy line and submerging it twice, the tenders will take you off searching signals and lead you back to the area of the descent line.

6. Diver will give proper line-pull signals and voice communications and come to the surface.

7. On the surface, go to ladder, open Supplementary Exhaust, close Air Control Valve, come up the ladder and begin undressing procedure.

SELF TEST ITEMS

1. Are you maintaining proper buoyancy control so that you're neither too light or too heavy?

2. Are you responding to tender's signals properly?

3. Are you moving as quickly as possible?

JOB SHEET 6-2-3J

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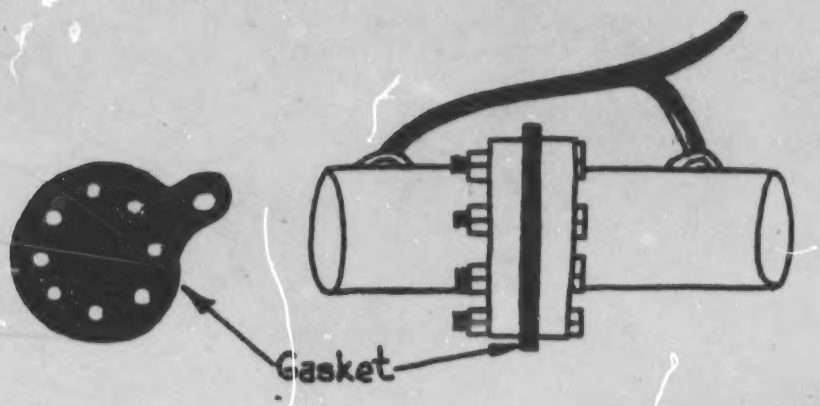
TITLE: Mk V Deep Sea Diving System Diver Single Flange Project, Seventeen Stud Pontoon Project, and Tooker Patch Project



INTRODUCTION

The projects in this unit of instruction require a degree of mechanical ability and manual dexterity. From the now familar Single Flange Project (as in Orientation) to the Tooker Patch (used in Salvage Operations), success will be dependent upon your hands and ability to use tools. Remember, as in Orientation, work as quickly as you can, but be thorough. You must successfully complete at least two of these projects to satisfactorily complete the unit.

If possible, each student should practice the projects on the surface when time permits - either during on-duty or off-duty hours when you're not required to be elsewhere. A meaningful way to practice is to blindfold yourself and, wearing a pair of diving gloves, perform the steps of disassembling/reassembling the project.

REFERENCES

Diving Training Standards

EQUIPMENT AND MATERIALS

Diving Underwear, Diving Socks, Tool Bag, Mk V Deep Sea Diving System, Single Flange, Seventeen Stud Pontoon and Tooker Patch Projects Material

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JOB SHEET 6-2-4J

1. SINGLE FLANGE PROJECT (Picture on Preceeding Page)

a. Diver uses proper line-pull signals and descends to the bottom (at least 20 feet) via ladder and descent line.

b. Get equipment squared away and, when ready, report to the instructor that you're ready to begin the project. Begin project.

c. Disassembly:

(1) Remove nuts, bolts and gasket.

(a) Put nuts and bolts in the tool bag.

d. Send for a square mark (via line-pull signals).

e. Secure gasket to square mark and send it topside.

f. Recover gasket from topside.

g. Reassemble in reverse order from disassembly.

h. Use proper line-pull signals and voice communications and come to the surface.

SELF TEST ITEMS

1. Are you working as quickly as possible?

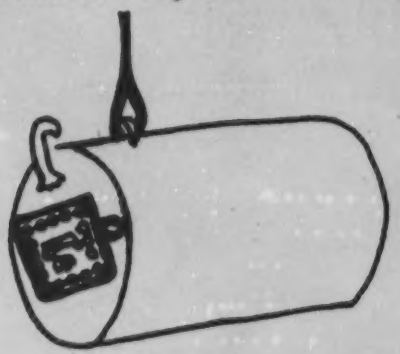
2. Are you working as thoroughly as possible?

3. Are the bench marks properly aligned upon reassembly?

4. Are at least six nuts and bolts wrench tight?

JOB SHEET 6-2-5J

2. Seventeen Stud Pontoon Project



a. Diver uses proper line-pull signals and descends to bottom.

b. Project has been placed on the bottom via project whip.

c. Loosen all nuts.

d. Remove all nuts except those on the four corners. Place nuts in tool bag as they are removed.

e. Remove three of the remaining four nuts and place them in the tool bag.

f. Back off the remaining nut to within two threads and request square mark from topside (via line-pull signals).

g. Secure the square mark to the rubber gasket, remove final nut and patch.

h. Send the gasket to the surface.

i. Recover gasket, set in place, and put four corner nuts in place. Screw down hand tight.

j. Place remaining nuts on studs hand tight.

k. Secure all nuts wrench tight beginning with center nut on each side and working to corners.

l. Request air hose from topside.

m. Secure air hose to air fitting on the project.

n. Use proper line-pull signals/voice communications and come to the surface.

o. After diver is on the surface being undressed, the instructor will raise project by floating.

SELF TEST ITEMS

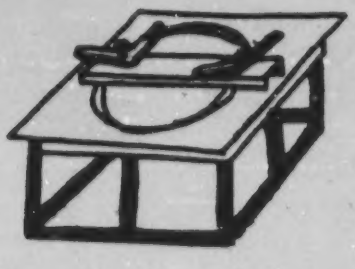
1. Are you working as quickly as possible?

2. Are you working as thoroughly as possible?

3. Are at least thirteen nuts wrench tight?

JOB SHEET 6-2-7J

3. Tooker Patch Project



a. Diver uses proper line-pull signals/voice communication and descends to the bottom.

b. Project has been placed on the bottom via project whip.

c. Diver removes two wing nuts from patch studs. Place in tool bag.

d. Diver removes the strong back.

e. Diver requests square mark.

f. Secure strong back to square mark and send it topside.

g. Receive strong back from topside.

h. Reassemble project in reverse order of disassembly.

i. Give proper line-pull signals/voice communications and come to the surface.

j. Once diver is on the surface being undressed, instructor will raise the project via project whip.

SELF TEST ITEMS

1. Are the wing nuts tight?

2. Is the patch properly seated?

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ASSIGNMENT SHEET 6-3-1A

TITLE: Mk V Deep Sea Diving System Tender (Underwater Basic)

LESSON TOPIC OBJECTIVES

Terminal Objectives

1. When the student completes this course, he will be able to, as a member of a team tending a diver using the Mk V Deep Sea Diving System in open water:

a. Given directions by the topside supervisor (instructor) guide the diver through the Searching Project (in accordance with Diving Training Standards) by using correct searching line-pull signals.

b. Use correct telephone and line-pull communications procedures throughout all training dives.

c. Dress a diver in a Mk V Deep Sea Diving System, within twelve minutes, so that he may safely enter the water.

d. Under instructor guidance, prepare the Mk V Deep Sea Diving System for daily use and secure the gear upon completion of daily diving activities.

e. Demonstrate correct maintenance of the Diving Log (including OPNAV Form 9940/1) without error.

Enabling Objectives

1. List, in writing, all searching line-pull signals.

2. Using a short line between two persons, demonstrate all searching line-pull signals.

3. Describe, orally, operation and communication procedures for the use of the Mk V Deep Sea Diving System Phone during normal operations (monitoring the dive, underwater cutting and welding, and monitoring the pneumofathometer).

4. Describe, orally, operation and communication procedures for use on the Mk V Deep Sea Diving System Phone during abnormal operations (i.e. loss of power, loss of communications, loss of gage readings).

5. Describe, in writing, correct procedures for maintaining a diving log during normal/abnormal operations as described in 3 and 4 above.

6. Orally explain the function of the OPNAV Form 9940/1.

7. Orally explain the function of the Report Overlay and Report Form of the OPNAV Form 9940/1.

ASSIGNMENT SHEET 6-3-2A

8. Describe, in writing, the proper completion of the OPNAV Form 9940/1, during normal operations, without error.

9. Orally explain the steps and equipment checkout involved in securing the Mk V Deep Sea Diving System from daily use (particular attention to cleaning and stowing).

STUDY ASSIGNMENT

U.S.Navy Diving Manual, Volume I, Paragraphs 6.3, 8.5.1.6, Appendix B and Table 6-3

STUDY QUESTIONS

1. If a diver has both voice and line-pull communication capability, which is the primary system?

2. Are diver-to-diver communication possible in Mk V gear? Explain.

3. How can the phone talker minimize the sound of hissing air from the diver when using the Model 1 Intercommunication System?

4. During use of the Model 1 Intercommunication System on a Mk V Deep Sea Diving System station, would there ever be an occasion when radio terminology such as "over" would be used? If yes, when?

5. What is the major difference between the Model 1 and Model 2 Intercommunication Systems?

6. List the steps for correct procedures should telephone communications fail while using the Mk V Deep Sea Diving System.

a.
b.
c.
d.
e.

f.

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ASSIGNMENT SHEET 6-3-3A

7. One objective of the diving record system is to provide data for analysis. What does this mean in terms of fleet operations?

8. Where are completed OPNAV Forms 9940/1 sent?

9. When would a narrative be required on the OPNAV Form 9940/1?

10. What is the purpose of a personal diving record?

11. Who is responsible for the currency of the Diver's Personal Diving Record and Diving Duty Summary Form?

12. Should an individual fail to retain diving qualifications or separate from active duty, what is the disposition of the Diving Duty Summary Form?

13. The drawing on the next page is to test your knowledge of Searching Line-pull Signals. The situation is that the diver has just entered the water and is on the bottom. In order to get him to the objective, list the signal (or signals) in the spaces provided at the bottom of the page that you, as the tender, would give the diver at the numbered points (1 , 2 , etc) along his path. Note: The dotted line indicates the diver's <u>actual</u> path of travel, including direction (arrows).

ASSIGNMENT SHEET 6-3-4A

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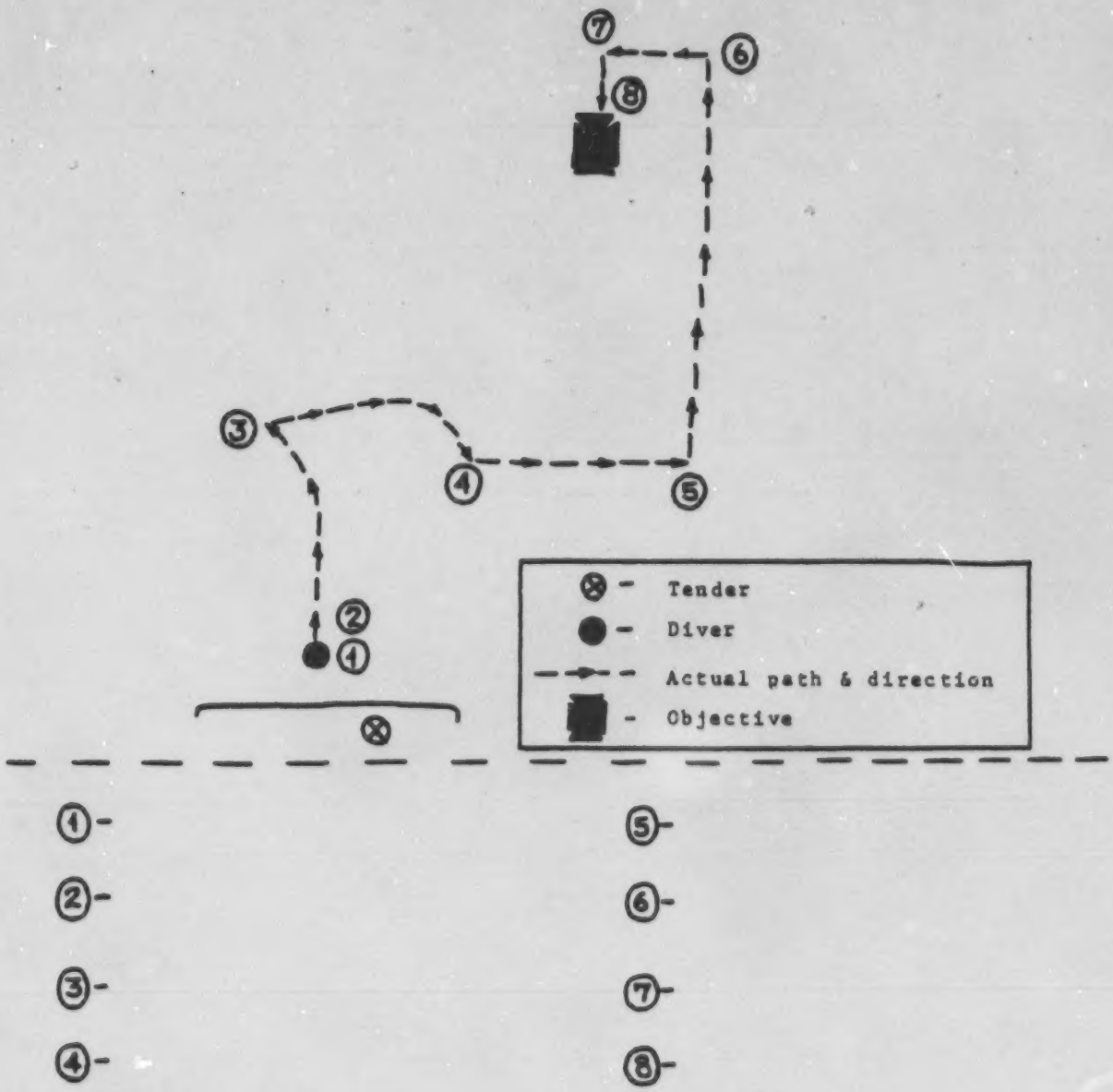
SEARCHING LINE-PULL SIGNALS



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NOTETAKING SHEET 6-1-1N

TITLE: Mk V Deep Sea Diving System (Underwater Basic)

REFERENCES

U.S.Navy Diving Manual, Volume I

NOTETAKING OUTLINE

A. Umbilical

1. Standard Deep Sea Hose - carries _____ _____ to diver.

a. Air Hose Fittings

(1) Male/Female to secure two lengths of _____ or secure hose to _____/_____ supply.

(2) Made of _____ to prevent corrosion.

b. Hose Washer - used when securing hoses together or to helmet for a _____ _____.

(1) Made of _____

(2) Check when _____ up _____.

(3) _____ _____ _____ used to preserve washer and to aid in making _____.

2. Lifeline/Telephone Cable - voice and line-pull communications.

a. Secured to _____ by lanyards.

3. Pneumohose - _____ measuring device; records _____ of _____.

a. _____ inside diameter _____ hose.

4. Siezing Stops - used to marry _____ _____, _____ _____ and _____.

a. Uses _____ every _____ feet.

5. Hose Cover - protects the first _____ feet of umbilical from _____ and _____.

a. Made from _____ _____ sewn with _____ _____ stitch.

B. Air Control Valve

1. Hand Wheel

a. Used to _____ _____ _____ or _____.

b. Made of _____ to prevent corrosion.

2. Bracket

a. Secures _____ _____ in place.

b. Made of _____.

3. Cap Nut

a. Applies pressure on the _____ _____ gland.

b. Made of _____.

4. Stuffing Box Gland

a. Applies pressure on _____ _____.

b. Made of _____.

5. Packing

a. Forms _____/____-_____ seal.

b. Made from _____ _____ _____

6. Packing Rings

a. Forms water/air-tight seal.

b. Made of _____ .

7. Stuffing Box

a. Accepts _____.

b. Made of _____.

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NOTETAKING SHEET 6-1-3N

8. Ring Washer

a. Helps form _____.

b. Made of _____ - _____ _____ conforms better to the stuffing box.

9. Valve Stem

a. _____ and _____ air passage.

10. Body

a. Houses _____ _____.

b. Has _____ _____ for hose and hose leader.

c. Has the _____.

11. Securing Pad-eye

a. Secures _____ _____ _____ to breastplate at _____ _____.

12. Valve Jamming

a. Explanation: Jammed open or closed due to:

(1) _____ the hand wheel.

(2) _____

b. X-Valve

(1) _____ be jammed

C. Hose Leader - carries breathing media from _____ _____ _____ to _____.

1. Standard Deep Sea Hose

a. _____ feet and _____ feet _____ inches lengths.

b. Double _____ fittings.

c. _____ _____ _____ at each end.

D. Non-Return Valve - prevents _____

1. Cartridge Type

a. Body - houses _____; contains fittings for connecting to _____ and air _____ _____.

b. Valve Cartridge - holds _____ in place to form non-return _____.

c. O-Ring forms seal

2. Stem and Spring Type

a. Body - houses _____ parts; contains fittings for connecting to helmet and air hose leader.

b. Valve Guide - keeps valve _____ _____

c. Stem Guide (upper) - keeps _____ aligned.

d. Spring - returns _____ and _____ to seat when air pressure _____.

e. Valve Stem - guides _____ to seat

f. Stem Washer

(1) Forms _____

(2) Made of _____

g. Washer - forms _____

h. Locknut - keeps washer in _____

i. Stem Guide (lower) - keeps stem in line.

E. Helmet

1. Body

a. Protects the diver.

NOTETAKING SHEET 6-1-5N

b. Acts as a compartment for the _____ _____

c. A body to which other component parts are attached.

2. Swing Bolt and Wing Nut

a. Secures _____ during dive

3. Faceplate

a. Allows diver to see out front of helmet

b. Open while diver is being _____/_____.

c. Made of _____ and _____ _____ glass.

4. Viewports

a. Allows diver to see out of sides and top of helmet.

b. Made of brass and heat treated glass

c. Guards help hold glass in place and prevent accidental breakage. Made of Brass.

5. Supplementary Exhaust (Spitcock)

a. Allows for _____ _____ in buoyancy

b. Allows diver to take in a small amount of water to spit on _____.

c. Secondary Exhaust when working on diver's _____ _____.

d. Located on _____ _____ of helmet.

e. A _____ which moves up (_____) or down (_____).

f. Made of _____

6. Helmet Locking Device (Dumbell)

a. Placed in _____ position and locked with _____ _____ once helmet is in place on _____.

b. Prevents helmet from turning _____ of _____

c. Made of _____.

7. Air Hose Gooseneck

a. Attachment for _____ _____

b. Allows _____ to enter helmet

8. Communication Gooseneck

a. Attachment for _____/_____ _____.

9. Transceiver Recess

a. Holds transceiver in place in a position where it will not _____ the _____ _____.

10. Exhaust Valve Body

a. Houses the Exhaust Valve

11. Zinks

a. Prevents _____ of metal on helmet.

b. Next to _____ on _____ _____.

12. Air Deflector Channel

a. Channels air over ports to prevent _____ and _____.

13. Breastplate

a. Distributes _____ of helmet over diver's _____ and provides a means for a _____ _____ between helmet and _____ _____.

(1) Studs - serve to _____ breastplate to diving _____.

(a) Made of _____.

(2) Straps - fits over _____ at the studs, for seal.

(3) Washer - used at _____ of straps.

(a) Prevents _____ of dress.

(b) Aids in producing an even _____.

(c) Made of _____ - malable and corrosion resistant

(4) Gasket - keeps joint between helmet and breastplate _____.

(a) Made of _____

(b) Shims - may be needed to make minor _____ adjustments on gasket; made of _____ _____.

(5) Wingnuts - assure a watertight seal.

(6) Eyelets - devices used to secure _____ to breastplate.

(7) Lanyards - used to secure _____ and _____ _____ to breastplate.

(a) Made of _____ _____

(b) _____ long.

14. Reproducer

a. Provides _____ _____ _____ between diver and topside.

b. Located _____ the helmet - upper left between top and left port.

c. Speaker is made of _____ and a _____ to collect and transfer sound vibrations.

15. Exhaust Valve

a. Adjusting Hand Wheel

(1) Adjusts _____ of air remaining in the _____.

(2) Located between and slightly below right _____ and faceplate.

b. Secondary Spring

(1) _____ _____ for normal operations.

(2) Begins to open at _____ lbs pressure.

c. Secondary Spring Following Disc

(1) Enables the secondary spring to be depressed when over _____ lb pressure is applied.

d. Adjusting Sleeve Set Screw

(1) Holds adjusting sleeve in proper _____.

e. Retainer Ring

(1) Prevents adjusting _____ _____ from unscrewing from exhaust valve _____.

f. Bonnet

(1) Inside _____ for hand wheel

(2) Prevents hand wheel from _____ when closed

g. Bonnet Guard

(1) Secures bonnet in place.

h. Primary Valve Spring

(1) Allows _____ psi to remain in dress.

(2) Takes 1/2 psi to _____ _____.

i. Adjusting Sleeve

(1) Allows adjustment of _____ _____.

j. Stem Valve Disc

(1) Acts as _____ to valve body, keeping _____ in dress.

k. Valve Stem

(1) Carries the _____ _____ away from seat when springs are _____.

NOTETAKING SHEET 6-1-9N

1. Chin Button

(1) Allows diver to adjust _____ inside the helmet.

(2) Helps prevent accidental _____.

F. Diving Dress

1. Rubber Gasket

a. Forms junction with _____.

2. Cuffs

a. Made of _____

b. Provide _____ _____ around wrists.

3. Gloves

a. Prevent _____ and guard against _____.

4. Wrist Straps

a. Used to:

(1) prevent hands from _____ from _____

(2) adjust _____ of sleeve.

(3) can be used with _____ to temporarily secure a pair of _____.

b. Made of _____.

5. Laces

a. Used to tie _____ of dress to prevent excess _____ _____.

b. Made of _____.

6. Grommets

a. Prevents laces from _____ _____.

b. Made of _____.

7. Body

a. Protects the diver

b. Aids in forming a watertight environment for diver.

8. Chafing Patches

a. Protects dress at _____ areas.

9. Bib

a. Serves to _____ any water that may enter the _____ through the _____.

G. Weight Belt

1. Belt

a. A means of placing _____ around diver uniformly.

b. Made of _____

2. Weights

a. Provide _____ _____

b. _____ weights of _____ pounds each.

3. Shoulder Straps

a. Prevents weight belt from _____.

4. Jock Strap

a. Prevents _____ and _____ from rising off diver's _____.

b. Made of _____.

H. Utility Tool

1. Used for _____, _____, _____ or cutting.

NOTETAKING SHEET 6-1-11N 251

I. Shoes

1. Lead Sole

a. Used to overcome _____ _____.

b. Aids the diver in remaining _____ in water.

2. Hardwood Upper Sole

a. A means of securing lead sole to _____

_____.

3. Uppers

a. A means of securing _____ to diver's foot securely.

4. Lacing

a. Assists in securing _____ to _____.

b. Made of _____ _____.

5. Leather Straps

a. Assists in securing shoe to foot.

b. Aids in preventing laces from becoming _____.

6. Toe Guard

a. Protects diver

NOTETAKING SHEET 6-3-1N
TITLE: Mk V Deep Sea Diving System Tender (Underwater Basic)

REFERENCES

U.S.Navy Diving Manual, Volume I

NOTETAKING OUTLINE

A. Communication Procedures

1. Normal Conditions

a. Monitoring the Dive

(1) Tender will normally _____ the diver by taking up _____, getting the feel of the _____ _____, and then giving more slack.

(2) Phone Talker will initiate conversations with the diver at the _____ of the _____ _____.

(3) Line-pull Tenders and Phone Talkers will _____ the _____ _____.

(4) Both will _____ to diver as necessary.

b. Cutting and Welding

(1) Safety precautions make it desireable to have as much _____ with the diver as possible during the time the _____ _____ is "on".

(a) Possibility of diver being _____.

(b) As a rule, should the tender have no communication from the diver for _____ minutes after "_____ _____", he should query diver, after placing knife switch in "off" position.

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NOTETAKING SHEET 6-3-2N

c. Monitoring the Pneumofathometer

(1) Constant monitoring during _____ and _____

(2) _____ _____ will dictate how much monitoring is required during the dive

2. Abnormal Conditions

a. Loss of power/communications

(1) Go IMMEDIATELY to _____ _____

(2) Check the rising _____ of _____

(3) Listen for _____ _____ _____

(4) If sounds are not heard, circuit may be out of order. If the flow of bubbles seems normal, diver may be alright.

(5) If sounds are heard, but diver does not respond, assume: _____ _____ _____ _____.

(6) If another diver is on the bottom, have him _____, or send down the _____ _____.

(7) If there is doubt about the diver's condition: begin _____ _____ _____ _____ _____ IMMEDIATELY.

b. Loss of Gauge Readings

(1) Most serious when: _____ and _____ of dive require _____ _____

(2) Actions

(a) If using a diving stage: use marks on _____ _____

(b) Lengths of _____ _____ could be used (Marked by joints every _____)

(c) Best method is to _____ a measured _____ to diver. Sliding shackle on _____ _____ held in position at _____ level, or let diver hold _____ _____ during ascent, or any other like method as directed by the _____ _____.

3. Procedures

a. As a Phone Talker: refer to Diving Training Standards for Communications

b. Line-Pull Signals

(1) Searching Line-Pull Signals

(a) 7 Pulls -

(b) 1 Pull -

(c) 2 Pulls -

(d) 3 Pulls -

(e) 4 Pulls -

(2) Searching Signals (with circling line)

(a) 7 Pulls and 1 Pull - _____ _____ _____

(b) 3 Pulls - _____ the weight and move _____

(c) 4 Pulls - _____ the weight and move _____

(3) Review of Special Signals from the Diver

(a) 1-2-3 Pulls - Send me a _____ _____

NOTETAKING SHEET 6-3-4N

(b) 5 Pulls - Send me a _____.

(c) 2-1-2 Pulls - Send me a _____.

(4) Grading Standards for Line-Pull Signals

(a) Refer to Diving Training Standards for Communications.

B. Diving Log

1. Normal Diving Operations

a. Kept on diving station in regular _____ _____ _____ notebook.

b. Left Column:

(1)

(2)

(3)

(4)

(5)

(6) For School Only

(a)

(b)

(c)

c. Right Column

(1) LS -

(2) RB -

(3) LB -

(4) RS -

(5) TDT -

(6) TBT -

(7) TTD -

(8) For School Only:

(a)

d. First Dive of the Day will also have the following entry written across the top: "_____ and _____ Tested by:"

2. Abnormal Operations

a. Accidents, incidents, etc. should be entered in the _____ section.

(1)

(2)

C. OPNAV FORM 9940/1 - Combined Diving Log - Accident/Injury Report

1. Background

a. Formal report for reporting diving information for _____ _____ _____.

b. Completed by all Navy diving activities, military and civilian, excluding submarine school students in escape training, unless an _____ or _____ is incurred.

c. Forwarded to:

_____

_____ _____ _____

_____ _____ _____

_____, _____ _____

Attn: Code 88

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NOTETAKING SHEET 6-3-6N

d. Must be sent within _____ days of dive.

e. In case of death, forward forms to:

Armed Forces Institute of Pathology

Washington, D.C. 20012

Attn: Marine Bropathology Branch

plus one copy to: _____ _____ _____.

STUDENT GUIDE

FOR

DIVER, SECOND CLASS (A-433-0022)

MEDICAL DEEP SEA DIVING TECHNICIAN (A-433-0020)

SHIP SALVAGE DIVING OFFICER (A-4N-0011)

DEEP SEA (HeO2) DIVING OFFICER (A-4N-0010)

VOLUME D

Medical Aspects of Diving

PREPARED BY

NAVAL SCHOOL DIVING AND SALVAGE

PREPARED FOR

SERVSCOLCOM,SDIEGO

SUBTRACENPAC,PHARBOR

NAVSCOLDIVSAL,WASH

31 OCTOBER 1975

INFORMATION SHEET 3-1-1I

TITLE: Resuscitation

INTRODUCTION

This information sheet and subsequent assignment sheet will provide background knowledge for you to perform resuscitation. Hopefully, your total practical resuscitation experience will be with "Annie" - a mechanical dummy used for practice, but you never know. On a diving station, you never know when one diver will surface bringing his buddy, an unconscious diver, in. Or, you never know when someone will choke on a piece of food - even his own saliva. Whatever the situation, if breathing stops, it's time to begin resuscitation. It's an extremely important skill to develop.

REFERENCE

U.S.Navy Diving Manual, VOL. I

ASSIGNMENT SHEET 3-1-1A

TITLE: Resuscitation

LESSON TOPIC OBJECTIVES

Terminal Objective
1. When the student completes this course he will be able to demonstrate proper procedures for the application of mouth-to-mouth and mechanical (AMBU) resuscitation.

Enabling Objectives
1. Orally describe emergency situations in which artificial respiration/resuscitation would be used.

2. Orally explain the necessity for maintaining free unobstructed airway while administering artificial respiration/ resuscitation.

3. Orally explain the procedures for proper administration of artificial respiration/resuscitation.

4. Orally describe the use of the mouth-to-mouth method of artificial respiration/resuscitation using a plastic arway.

STUDY ASSIGNMENT

U.S. Navy Diving Manual, VOL. I, Paragraph 8.1.1

STUDY QUESTIONS

1. Define the term reuscitation.

2. _____ resuscitation restores breathing and _____ resuscitation is to re-establish heart action.

3. What is the first action taken by someone administering resuscitation?

4. Mouth-to-mouth resuscitation is one form of:

ASSIGNMENT SHEET 3-1-2A

5. When administering mouth-to-mouth resuscitation, what is the normal rate of the breathing cycle for adults?

6. Mouth-to-mouth resuscitation must be continued _____ _____.

7. What does AMBU mean?

8. How long can the heart beat be interrupted before irreversible damage occurs?

9. Closed-chest cardiac massage is a method for:

10. How long should cardiac massage be continued?

ASSIGNMENT SHEET 3-2-1A

TITLE: Hemmorrhage Treatment

LESSON TOPIC OBJECTIVES

Terminal Objective
1. When the student completes this course, he will be able to demonstrate the treatment of hemmorrhage through the utilization of direct pressure methods.

Enabling objectives

Orally explain the conditions that warrant the use of a turniquet.

Orally state the danger of loosening a turniquet.

Orally explain the direct pressure method of treatment of hemmorrhage stressing areas of the body where the method is applicable.

STUDY ASSIGNMENT

U.S. Navy Diving Manual, VOL. I, paragraph 8.1.2

STUDY QUESTIONS
1. How is arterial bleeding identifiable?

2. What are the first aid procedures for internal bleeding?

3. What is the best way to control external arterial hemmorrhage?

ASSIGNMENT SHEET 3-2-2A

4. What are the disadvantages of the pressure point method of controlling hemmorrhage?

5. When should a tourniquet be used to control arterial hemmorrhaging? Why?

ASSIGNMENT SHEET 3-3-1A

TITLE: Shock

LESSON TOPIC OBJECTIVES

Terminal objectives
1. When the student completes this course he will be able to demonstrate the first aid treatment for victims of shock.

Enabling Objectives.
1. Orally state the most common cause of shock.

2. Orally describe the symptoms of shock.

3. Orally explain the procedures of treatment of victims of shock.

STUDY ASSIGNMENT

U.S. Navy Diving Manual, VOL. I, paragraph 3.3.6

STUDY QUESTIONS
1. Define the term "shock" as it applies to medical emergency situations.

2. In victims of shock, only the brain is affected?

True/False

ASSIGNMENT SHEET 3-5-1A

TITLE: Diving Disease/Injury Treatment

LESSON TOPIC OBJECTIVES

Terminal Objectives
1. When the student completes this course, he will be able to, given a hypothetical case involving a disease/injury/condition common to diving, describe, in a sequence of steps, appropriate action. Include, as a minimum, name of disease/injury/condition, selection of proper treatment table, if appropriate, treatment and post treatment actions. If treatment tables are necessary, make correct log entries.

Enabling Objectives.
1. Circulatory/Respiratory Systems.

   a. List, in writing, the major organs in each system.
   b. Given an illustration of the systems, trace a drop of blood and a molecule of air through the applicable system.
   c. Orally describe the interface of the two systems and their importance to diving.
   d. Describe, in wriging, the manner in which selected conditions hinder normal operations of the systems.

2. Describe, in writing, the symptoms, causes, and proper methods of prevention/treatment for selected diver's diseases and injuries.

3. Treatment Tables.

   a. Orally list the tables used in recompression breathing (except saturation).
   b. Explain, in writing, the application of selected equipment and devices used in recompression treatment.
   c. Define, in writing, selected terms used in recompression treatment.
   d. Given selected conditions, describe, in writing, the sequence of steps for treatment.
   e. Explain, orally, the need for recompression treatment and treatment tables.
   f. Orally describe the fundamentals involved in selecting the proper treatment tables.

ASSIGNMENT SHEET 3-5-2A

g. Describe, in writing, the symptoms of oxygen poisoning.
h. Describe, in writing, the most frequent errors related to treatment.
i. Orally describe the fundamentals involved in recompression treatment in the water.
j. Describe, in writing, the most vital features of hyperbaric chamber use.
k. Orally describe the two basic types of treatment tables.
l. Describe, in writing, the precautions that must be taken when transporting divers requiring decompression treatment.
m. Orally describe the decompression of treatment tenders.
n. Explain, in writing, the function(s) of the components below in terms of what it does for the system; source of information required for its use; describe the components; and explain the application or uses:

    (1) Treatment table for decompression sickness and air embolism.
    (2) Treatment table for minimal recompression O_2 breathing.

o. For each treatment table component (section) describe, orally, the physical location and application or use.
p. Given the following, state, the set point(s) in terms of the effects of operating above or below them.

    (1) Rate of ascent of each table.
    (2) Rate of descent for each table.
    (3) Time/depth limits for each table.

q. Orally describe the effect on the treatment table system due to the Hyperbaric Chamber System.
r. Orally describe the safety precautions unique to the treatment table system.

    (1) Accurate time and record keeping.

NOTE: THE COURSE DOES NOT INCLUDE ASSIGNMENT SHEET 3-4-1A.

ASSIGNMENT SHEET 3-5-3A

TITLE: Diving Disease/Injury Treatment (PHASE I)
(Circulatory and Respiratory Systems)

STUDY ASSIGNMENT

U.S.Navy Diving Manual, VOL. I, Pages 3-1 through 3-13

STUDY QUESTIONS.

1. Define the following terms:

a. Anatomy:

b. Neuron:

c. Metabolism:

d. Respiratory System:

e. Vena Cava:

f. Venules:

g. Atrium:

h. Hemoglobin:

i. Platelet:

j. Cardiac Output:

k. Diastolic Pressure:

ASSIGNMENT SHEET 3-5-4A

1. Inspiratory Reserve Volume:

m. Vital Capacity:

n. Alveoli:

o. Hyperventilation:

p. Peripheral Chemoreceptors:

2. List the major organs in the following systems:

a. Nervous System: 1.
2.
3.

b. Respiratory System: 1.
2.
3.

c. Circulatory System: 1.
2.

3. What are the functions of the skeletal system:

1.

2.

4. Metabolism is influenced by:

5. Cells in the _____ normally use 20% of the entire blood's oxygen supply. Without oxygen they will begin to die within _____.

ASSIGNMENT SHEET 3-5-5A

6. The _____ are the largest and strongest of the blood vessels, and always carry blood being pumped _____.

7. The capillaries mark:

   1.

   2.

8. List the four main components of blood, what percentage of the whole each is, and a brief description of each.

9. Describe the function of the sinus node.

10. Explain the terms "external" and "internal" respiration.

11. What is the residual volume of the lungs after exhaling?

12. Explain the relationship between Boyle's Law and oxygen consumption.

NOTE: ASSIGNMENT SHEET 3-5-6A HAS BEEN DELETED; HOWEVER ALL MATERIAL IS INCLUDED.

ASSIGNMENT SHEET 3-5-7A

THE STRUCTURE OF THE BODY

Label the major systems of the body and the major components of each system. For ease of identification, it would be good to "color code" each system.

ASSIGNMENT SHEET 3-5-8A

TITLE: Diving Disease/Injury Treatment (PHASE II)
(Diving Disease/Injury Recognition)

STUDY ASSIGNMENT

U.S.Navy Diving Manual, VOL. I. Page 3-14 thru 3-24 and page 8-1, 8-5 thru 8-13.

STUDY QUESTIONS.

1. What is the first part of the body affected by Hypoxia? How is it affected?

2. At what level must the partial pressure of oxygen at operating depth be maintained:_____ What would happen if the partial pressure of oxygen at operating depth dropped below 0.6?_____

3. What is the best method for preventing Hypoxia?

4. What is the most common source and cause of hyper capnia?

5. Define Asphyxia.

6. What is the most common cause of carbon monoxide poisoning?

7. What is the difference in symptoms displayed by a victim of hypoxia and one of carbon monoxide poisoning?

8. What is the treatment of choice for carbon monoxide poisoning?

ASSIGNMENT SHEET 3-5-9A

9. Describe two methods by which the body loses excess heat.

10. How long would an average built unclothed man survive in water 42°F? _____

11. What is the most efficient method of recovering body temperature rapidly?

12. Squeeze affects only spaces which have _____ _____ whether inside the body or in a piece of equipment.

13. Describe the eustachian tube.

14. How can the effects of squeeze during a dive be limited?

15. Describe thoracic (lung) squeeze.

16. Why should you not wear goggles when diving SCUBA?

17. What is the greatest hazard of nitrogen narcosis?

18. What is the reason for divers submitting to an oxygen tolerance test?

ASSIGNMENT SHEET 3-5-10A

19. What is the diver's greatest opportunity for being exposed to potential oxygen poisoning?

a. During an operational dive using air at a depth of 180 feet.
b. During recompression treatment using oxygen.

20. Which is the clearest warning of oxygen toxicity?

21. What is the most important consequence of oxygen toxicity? How is it treated?

22. Fatty tissues will absorb more or less nitrogen as watery tissues? How much?

23. What is the major difference between saturation and desaturation?

24. Describe decompression sickness.

ASSIGNMENT SHEET 3-5-11A

25. How does the use of oxygen during decompression reduce the time required for controlled decompression?

26. Gas embolism is caused by:

27. List three specific instances when a gas embolism could occur.

a.
b.
c.

28. Describe the following:

a. Interstital Emphysema -

b. Subcutaneous Emphysema -

c. Mediastinal Emphysema -

d. Pneumothorax -

29. A shock wave moves more quickly, and is more pronounced in water than in air. Why?

ASSIGNMENT SHEET 3-C-12A

3C. What factors would affect the amount of damage to a diver from an explosion?

a.

b.

c.

d.

e.

f.

ASSIGNMENT SHEET 3-5-13A

PART II

1. Diving personnel requiring emergency medical treatment fall into one of two categories. Name them

a.

b.

2. List the four immediate actions taken in any diving medical emergency.

a.

b.

c.

d.

3. _____ should be given in almost every case of unconsciousness simply because it is seldom possible to be certain that it is _____ _____.

4. The prevention of drowing is best insured by:

a.

b.

5. List the two phases of treatment of drowning and near-drowning.

a.

b.

6. At water temperatures below 77°F, exercise will _____ the loss of body heat.

7. In a case where a person has been exposed to cold water and is apparently dead, what treatment would be appropriate?

ASSIGNMENT SHEET 3-5-14A

8. Heat exhaustion is always a possibility when working in waters above_____.

9. As a basic rule, any diver who may have obtained a breath from any source at depth - whether from diving apparatus or from a diving bell - and who is unconscious or soon loses consciousness upon reaching the surface, must be assumed to:

10. Complete the following: Any doubt as to correct diagnosis must be resolved _____ _____ ____ _____ _____ - _____ _____ _____.

11. List ways to prevent decompression sickness.

a.

b.

c.

d.

e.

f.

12. The most common symptom of decompression sickness is _____ which has occured in _____% of the cases.

13. Why should abdominal pain be treated as a serious symptom?

ASSIGNMENT SHEET 3-5-15A

14. If there are any signs of nervous system involvement in decompression sickness, the diver should be

_____.

15. While attempting to complete the searching project, the diver inadvertently blows up to the surface from 30 feet. He is pulled to the ladder by his tenders, comes up and is being undressed. He reports that he feels weak and thinks he's going to faint. His breathing is labored and he complains of pain around the heart. Within 4 minutes of reaching the surface, he passes out. What would be your diagnosis?

16. During a working dive at 150 feet, the diver begins singing, but his voice is heavy and words are slurred, what is your diagnosis? How would you treat him?

17. During ascent from a working dive at 120 feet, the diver complains of sharp pain in his lower abdomen. What is your diagnosis? What is the immediate treatment?

18. A SCUBA diver is on the surface after swimming 500 yards on a compass course at a depth of 35 feet. During removal of his SCUBA cylinders, the diver collapses, unconscious. What is your diagnosis? Treatment?

19. Describe how one prevents gas embolism during an emergency or free ascent?

20. During recompression treatment using 100% oxygen, the victim becomes nauseous and begins twitching. What is your diagnosis? Treatment?

NOTE: ORIGINAL PAGES 3-16A HAS BEEN DELETED; HOWEVER ALL MATERIAL HAS BEEN INCLUDED.

ASSIGNMENT SHEET 3-5-17A

TITLE: Diving Disease/Injury Treatment (PHASE III)
(Treatment Tables)

STUDY ASSIGNMENT

U.S. Navy Diving Manual, VOL. I, Pages 8-13 through 8-26

STUDY QUESTIONS.

1. What are the six most important facets of recompression treatment?

a.

b.

c.

d.

e.

f.

2. If the diving facility is not equipped with a recompression chamber, what two alternatives are available to the diving supervisor?

a.

b.

3. When preparing a victim for recompression chamber treatment, why is it important to keep him lying down, feet slightly higher than his head, with his body tilted 20° to the left side?

4. What precautions should be taken if transporting a victim to a recompression chamber by air? Why?

a.

b.

ASSIGNMENT SHEET 3-5-18A

5. Never recompress a diver in the water using a _____ with a _____.

6. What action is taken if, during water recompression treatment, the depth available is inadequate for full treatment according to the tables?

1.

2.

3.

7. The preferred procedure for recompression treatment are the _____.

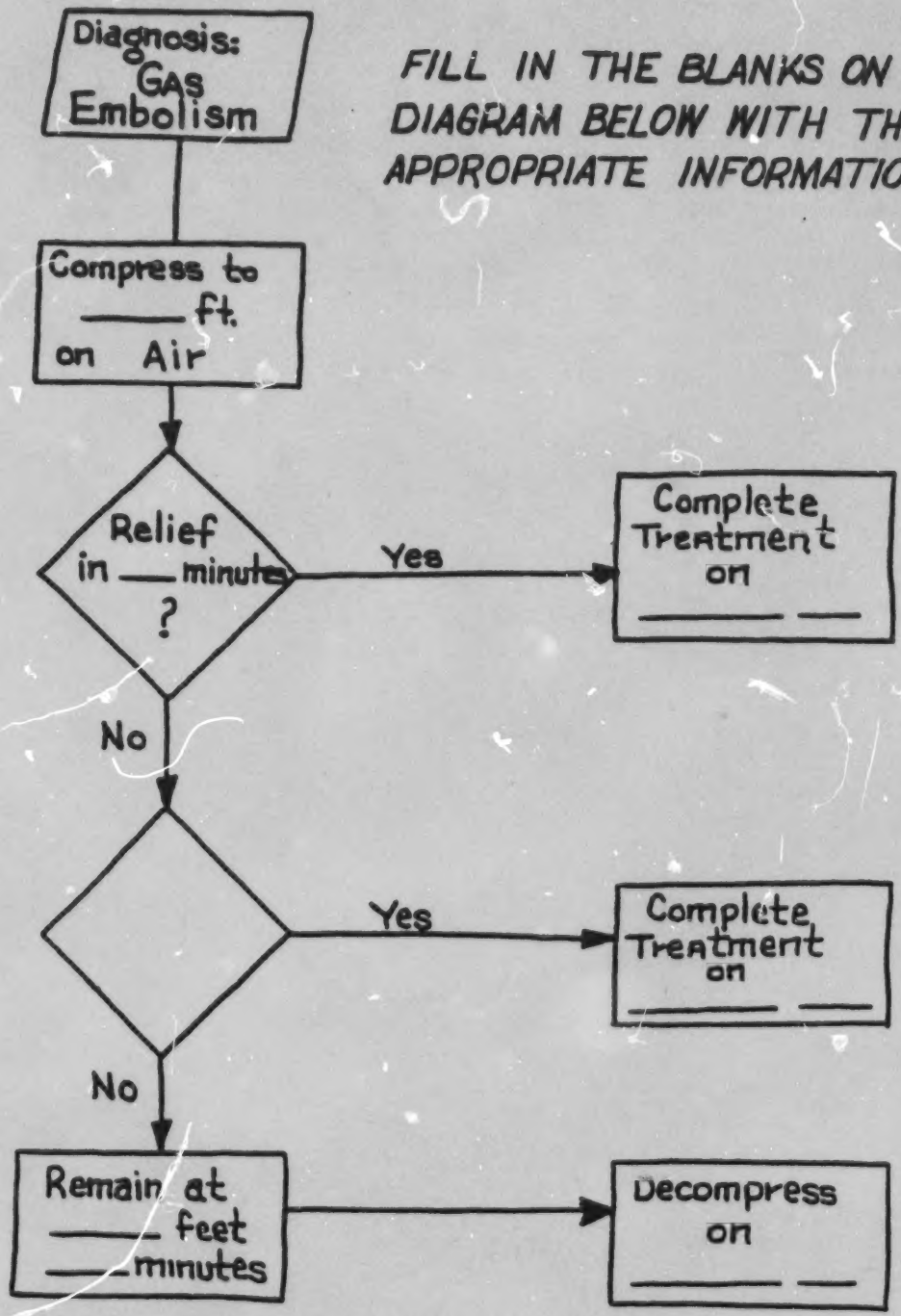
8. Explain the acronym "VENTID".

9. The maximum recompression depth employed in treatment is based upon:

10. What action is taken if after a patient has been maintained at the depth and time required by the selected table the symptoms persist?

NOTE: ORIGINAL PAGE 3-15-19A HAS BEEN DELETED; HOWEVER ALL MATERIAL HAS BEEN INCLUDED.

FILL IN THE BLANKS ON THE DIAGRAM BELOW WITH THE APPROPRIATE INFORMATION.



GAS EMBOLISM TREATMENT

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ASSIGNMENT SHEET 3-5-21A

CASE #1

After :22 at 119', a diver comes to the surface. His decompression was uneventful. One hour and 10 minutes after surfacing, he complains of a mild rash and some discomfort in both knees. After 06 minutes at treatment depth, all of his symptoms are gone.

What physiological phenomenon is the probable cause of the diver's symptoms?

What diagnosis would you make in this case?

What is the course of treatment you would recommend?

What post-treatment action is indicated for this accident?

ASSIGNMENT SHEET 3-5-22A

CASE #2

Two SCUBA divers came to the surface after :08 on the bottom at 48'. They both complained of severe headaches, and they both stated that their air "tasted funny". After proper treatment, both divers were asymptomatic.

a. What is the most likely cause of the divers symptoms?

_____ _____ _____

b. What facts lead you to this conclusion?

_____

_____

_____

_____

c. What is the correct course of treatment for this injury?

_____

d. Why did you elect this table?

_____

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ASSIGNMENT SHEET 3-5-23A

CASE #3

25 minutes after surfacing from a dive to 148' for 36 minutes, one of the divers complains to the supervisor of pain, itching and numbness in his right forearm. Physical exam reveals no other symptoms, and the symptoms are completely relieved at 33' during descent in the chamber.

a. What is the correct diagnosis in this case?

_____

b. What physiological activity is probably occuring in the divers body to cause these symptoms?

_____

c. What is the correct method of treating this diver?

_____

d. What is the correct post-treatment action to take?

_____

e. Why is this action taken?

_____

_____

ASSIGNMENT SHEET 3-5-24A

CASE #4

An HeO2 Diver surfaces from a dive to 210' after 14 minutes on the bottom. He experienced no difficulty on the dive. While he is being undressed on the stool, he becomes unconscious. He revives after :03 at treatment depth. He has no other symptoms, except that he complained of pain on coughing and expectorated a small amount of sputum tinged with blood.

a. What is the correct diagnosis for this man's injury?

_____

b. What is the correct action to be taken in managing the situation?

_____

c. What was the physiological effect of this action?

_____

d. What anatomical area of the body was most likely involved to cause such sudden and dramatic events?

_____

e. What treatment table should be used in treating the diver?

_____

f. What fact led you to this conclusion?

_____

_____

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ASSIGNMENT SHEET 3-5-25A

CASE #5

:15 after surfacing from a deep air dive (236/23), the diver complains to the supervisor of pain, swelling and a pins and needles sensation in his left elbow. Physical examination reveals a mild degree of skin rash in the same area. The diver experiences complete relief at 42' during descent. Oxygen is NOT available. After :38 at the 30' stop, the diver complains that the pain has returned and is located in his right knee. The pain is gone upon return to treatment depth.

What is the nature of the diver's original illness?

What is your clinical diagnosis of his problem?

How would you treat this problem?

What went wrong with the treatment?

How would you treat the subsequent symptoms?

ASSIGNMENT SHEET 3-5-86A

CASE #6

A SCUBA Diver is tethered to the surface with a piece of "6-thread". He is working in 68 feet of water. Upon completion of his task, he gave proper line-pull signals and began his ascent. At approximately 30 feet, the tenders felt the diver "get heavy". As they continued to pull the diver to the surface, the small tending line parted. The Standby Diver entered the water, quickly located the stricken diver and brought him to the surface. From the time the line parted until the diver was brought to the surface unconscious was 11 1/2 minutes. His respirations were rapid and shallow, and there was a distinct pink color to his lips. The diver regained consciousness as he was being brought aboard the diving platform, and had no other symptoms.

What is your explanation for the diver "getting heavy"? (List all possibilities)

What mistakes were made by personnel that may have contributed to the diver's condition?

What would be the correct way to handle this man when he got to the surface?

What is the best diagnosis you can make of the cause of the incident?

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ASSIGNMENT SHEET 3-5-27A

CASE #7

Six hours after surfacing from a dive to 132 feet for :43, with normal decompression, one of the divers complains of pain and swelling of his left knee. He gets relief of the pain at 36 feet on descent in the chamber, but the swelling persists for :12 after he reaches treatment depth. 1 1/2 hours after completing the treatment, he complains that the swelling has returned, and there is some numbness, but no pain. All his symptoms are relieved after :06 at treatment depth. There is no oxygen available.

What is the diagnosis of the original problem?

What table should he be treated on?

What is the diagnosis of the second set of symptoms?

How should the second set of symptoms be treated?

INFORMATION SHEET 3-6-1I

TITLE: Dangerous Marine Life

INTRODUCTION

As a diver, you spend much of your working time in an environment where man is an unwelcome alien. The creatures in the sea exist in a natural cycle involving a perpetual struggle for survival. Big creatures feed off smaller creatures, smaller creatures use both natural offensive and defensive weapons to kill or survive, and so it continues. The diver is a guest in this world of the sea, and he must be continually alert for potential danger from seemingly harmless creatures. A shark, a relatively large fish, can kill. A cone shell, a relatively small animal, can kill. This assignment is designed to help you become aware of the dangers associated with marine life, but the most important thing for you to remember is to respect the sea and the creatures who reside therein. They do not intentionally harm or kill humans, but if threatened, will do so with no thought whatsoever.

ASSIGNMENT SHEET 3-6-1A

TITLE: Dangerous Marine Life

LESSON TOPIC OBJECTIVES

Terminal Objective
1. When the student completes this course, he will be able to, given pictures/illustrations of marine life, identify with correct name, describe danger (if any) to divers, describe, in a sequence of steps, appropriate medical actions and precautions to avoid contact.

Enabling objectives
1. For each of the following species, describe, in writing, the physical characteristics, habitat and precautions to avoid contact, danger to divers (if any).

a. Sharks
b. Barracuda
c. Grouper
d. Moray Eel
e. Killer Whales
f. Sea Lions
g. Barnacles and mussels
h. Giant clams
i. Jelly fish
j. Corals
k. Octopus
l. Cone shells
m. Sea urchins
n. Sting rays
o. Venomous snakes
p. Sea snakes

2. Describe, in writing, the procedures for treatment of snake bites, venomous fish stings, stingray wounds and jelly fish stings.

3. Describe, in writing, the treatment for bites from shark and barracuda.

STUDY ASSIGNMENT

U.S. Navy Diving Manual, VOL. I, Appendix I

STUDY QUESTIONS

1. List below those sharks not dangerous to humans.

ASSIGNMENT SHEET 3-6-2A

STUDY ASSIGNMENT - STUDY QUESTIONS

2. List below those methods of preventing shark attacks which have proven useful.

a.

b.

c.

3. What is the fatality rate from shark bites?

4. Describe a barracuda. How does their bite differ from a shark?

5. Where are likker whales found? What is the best method of preventing attack?

6. List the hazards for the following poisonous fish:

a. Catfish

b. Scorpionfish

c. Ratfish

7. What is the treatment for jellyfish stings?

8. What is the hazard of annelids?

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NOTETAKING SHEET 3-1-1N

TITLE: Resuscitation

REFERENCES

U.S. Navy Diving Manual, Vol. I

NOTETAKING OUTLINE

I. General Considerations.

A. Terms

1. ECM - _____ _____ _____

2. MMR - _____ _____ _____

3. CPR - _____ _____

4. Cardiopulmonary Arrest - the absence of functional _____ and _____ in an individual not expected to _____.

5. Resuscitation - Action taken to restore cardiopulmonary vital signs of _____ and _____.

B. Both _____ _____ and lack of _____ may occur in the same victim.

1. When both conditions exist in the same person, _____ must be restored first.

a. If _____ is not started within _____ minutes, cerebral anoxia, "_____ _____" that cannot be reversed begins.

2. E.M.C. can be delayed until clear airway has been established and ventilation have been restored.

II. Pulmonary Resumitation

A. Causes of Pulmonary failure

1. _____ blockage of airway.

a. water _____

b. _____

c. _____

d. Foreign bodies (i.e. _____ _____)

NOTETAKING SHEET 3-1-2N

2. _____ of respiratory system.

a. damage to _____ or spinal _____.

1. _____ trauma.

2. _____action (poisoning).

b. _____ shock.

3. Disruption of respiratory _____ action due to _____.

4. Reactions to medicine, food, etc. (_____).

B. Pulmonary Resumitation - Restoring _____.

1. ABC's of Resumitation

a. A - maintain _____ _____.

b. B - _____ - insure respiratory exchange.

c. C- _____ output - check for pulse.

2. Mouth to Mouth Resuscitation Procedure

a. Open Victim's mouth

b. Extend head backward at the same time.

c. Check mouth for foreign matter.

1. If matter cannot be reached with forceps, Turn patient on one side and strike sharply between shoulder blades with flat palm of hand.

d. Pinch victim's nostrils.

e. Apply mouth to victim's mouth.

1. Cover mouth and nose of a small child.

2. Insure a seal.

f. Exhale into victim's mouth.

1. Watch for chest rise.

2. 800-1000cc is minimum amount required for adequate ventilation.

g. Repeat 10-12 times per minute for an adult, 20 time per minute for

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NOTETAKING SHEET 3-1-3N

a child.

h. Continue without interruption.

1. If victim revives, watch for further need of respirator assistances.

2. May be relieved by another person so long as procedure is not disrupted.

3. Continue until medical aid arrives.

4. Or for 3 ½ or 4 hours.

3. Mechanical Resuscitation "AMBU".

a. Preferable to Mouth-to-Mouth Method.

1. More positive _____.

2. Provides better _____.

3. Superior esthetic qualities.

4. Can be utilized with an _____ _____.

b. Operated by manual _____ of a pliable _____ _____.

c. Valuable tool for diving lockers.

1. Should be on diving platforms/boats and near the chamber.

C. Cardiac Resuscitation

1. Causes

a. _____ shock.

b. _____ shock

c. _____

d. Combination of injuries or conditions.

1. Hypoxia and _____.

2. Shock and _____.

3. Trauma, shock and _____.

4. Almost any other _____ _____ combination, if severe enough.

NOTETAKING SHEET 3-1-4M

2. Recognition

a. absence of a _____ in a major _____.

1. Check _____ _____ at the side of the _____.

2. _____ pulse is most commonly used. but can be difficult to locate.

b. Cyanosis - the condition of _____-_____ skin, lips and _____ _____, indicate circulation failure or lack of oxygen.

c. If heart action has been disrupted for _____ minutes, damage to the _____ will result.

1. Revival after _____ minutes will probably display some _____ damage.

2. Extent of brain damage is directly related to the _____ ____ _____ heart action was stopped.

3. Cardiac Resuscitation

a. External Cardiac Massage

1. Can artificially maintain _____ of blood flow to brain and vital organs.

2. Should be continued until:
a. Revival.
b. Stopped by _____ _____.

c. Carotid pulse has been absent for _____ minutes. After 3 ½ to 4 hours.

b. Procedures

1. Check for carotid pulse.

2. If cardiac arrest was witnessed, one sharp blow to the sternal area may restore heart action (performed by medical personnel only).

3. Place victim on rigid surface.

4. Kneel on either side of victim.

5. Place heel of one hand on the lower half of the sternum, with fingers pointing towards opposite armpit.

6. Place other hand over the first to give added force in overcoming rib cage resistance.

7. Get shoulders over wrists and lock your elbows.

8. Exert force downward, using body weight to depress the rib cage about 1 1/2 inches.

9. Release pressure.

10. Repeat the compression - release cycle.

11. Frequency should be approximately one cycle per second.

4. When both respiratory and cardiac arrest exist in the same victim.

a. Procedure.

1. Provide 3 quick ventilations.

3. Begin external cardiac massage.

4. Alternate ECM and Mouth-to-mouth Resuscitation on a ratio of eight compressions to two ventilations.

5. Recheck for carotid pulse every 3 minutes.

6. Maintain rhythm until:

a. victim revives.

b. victim is pronounced dead.

c. no pulse is detected for 15 minutes, or 3 ½ to 4 hours.

7. Send for medical assistance.

NOTETAKING SHEET 3-2-1N

TITLE: Hemorrhage Treatment

REFERENCES

U.S. Navy Diving Manual, Vol. I

NOTETAKING OUTLINE

I. Control of Massive Hemorrhage

A. Types

1. Arterial Bleeding

a. Bright _____ _____ color

b. _____ or spurts of blood coinciding with _____.

2. Veinous Bleeding

a. Dark _____ color

b. _____ _____

3. Capillary Bleeding – least serious

B. Location

1. External bleeding - easily seen

2. Internal bleeding

a. Signs

1. _____, _____ pale skin.

2. _____, _____ pulse.

3. Depressed blood _____

4. Possible _____

5. Presence of blood in _____, _____, _____ or in coughed up mucous.

b. Control is best left to _____ _____ _____.

c. Control

1. Direct Pressure Method

a. Apply pressure directly over the injury and apply firmly.

b. Use sterile bandage material, if available.

2. Tourniquet Application

a. Applied above injury on extremities only.

b. Closes blood supply below application.

c. Should be reserved for situations when later amputation is a likely possibility.

NOTETAKING SHEET 3-3-1N

TITLE: Shock Treatment

REFERENCES

U.S. Navy Diving Manual, Vol I

NOTETAKING OUTLINE

I. Shock Syndrome

A. Shock is the rapid _____ of _____ body centers.

1. _____ _____

2. Resultant loss of ____, _____ and some _____ retention.

B. Types

1. Oligemic Shock: _____

2. Emotional Shock: _____

3. Traumatic Shock: _____

4. Electrical Shock: _____

5. Toxic Shock: _____

C. Symptoms

1. Eyes: _____

2. Breathing: _____

3. Skin/lips: _____

4. Other: _____

D. Treatment

1. Lay victim down and elevate feet.

2. Deep warm.

3. Give small sips of liquids by mouth, if conscious.

4. Reassure victim and prevent them from viewing their injuries.

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NOTETAKING SHEET 3-4-1N

TITLE: First Aid Treatment

REFERENCE

U.S. Navy Diving Manual, Vol. I
Handbook of the Hospital Corps

NOTETAKING OUTLINE

I. General Principles

A. Purposes

1. Save _____

2. Prevention of _____ _____

3. Preservation of _____ in an _____ victim.

B. General Rules for Administration.

1. Keep victim in _____ position unless _____ indicates otherwise.

2. Determine the extent of injury.

a. Carefully remove _____ from around the wound.

b. Visually check for further (or other) _____ and priority _____.

c. Examine extremeties for _____ _____.

3. Do not attempt to _____ the victim until you have fully _____ him.

4. Do not give an unconscious victim _____ _____ _____.

a. May block _____.

b. May induce _____ or_____.

5. Try to prevent the victim from _____ his injury.

a. May induce or deepen _____.

b. May make further examination _____.

6. Reassure the victim

a. Allay his _____.

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b. Provide a _____ influence.

7. Act _____, _____ and efficiently.

C. Definition of Terms

1. First Aid - _____
_____

2. Wound - _____
_____

3. Fracture - _____
_____.

4. Trauma - _____.

D. Priorities

1. Serious_____.

2. _____ resusitation

3. Massive _____ and/or cardiac arrest.

4. Treat for _____

a. Present in _____ trauma.

b. _____ have occured as a result of seemingly inconsequential injuries.

5. _____ _____ _____

6. _____ _____

II. Wounds and their Management

A. Three Basic Rules

1. Stop _____

2. Reassure _____ _____ - close wound.

a. Apply a dressing.

b. _____

NOTETAKING SHEET 3-4-3N

c. Wound _____

3. Prevent _____

B. Types of Wounds.

1. Incision - _____.

2. Laceration - _____.

3. Contusion - _____
_____.

4. Abrasion - _____.

5. Puncture - _____
_____.

6. Crush Wound - _____
_____.

III. Fractures - Broken Bones

A. Classification

1. Closed or Simple - _____.

2. Open or Compound - _____
_____.

3. Greenstick - _____
_____.

4. Comminuted - _____
_____.

5. Impacted - _____
_____.

B. Management

1. Check for _____

2. _____the break

a. _____

b. Avoid _____

3. Treat for _____

IV. Burns

V.

A. Classification - made according to _____ of burned surface and the _____ of the lesion.

1. Total amount of surface involved is calculated roughly by the _____ of _____.

2. _____ induces schock (_____ for children)

a. _____ involvement endangers life.

b. _____is usually fatal.

3. Depth of lesion is referred to in _____.

a. 1st degree - _____ _____.

b. 2nd degree - _____ _____.

c. 3rd degree - _____ _____.

B. First Aid

1. Relieve _____, if possible.

2. Treat for _____.

3. Prevent _____.

a. Remove _____ carefully.

b. Avoid _____ and _____.

4. _____ _____ baths for areas of involvement less than _____.

a. alleviates _____

V. Heat Casualties

A. Hot environments require increased _____ to the skin to cool the body. Failure to meet this demand, causes:

1. Heat _____

2. Heat _____

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NOTETAKING SHEET 3-4-5N

B. Heat Stroke - emergency needing _____ attention.

1. Symptoms

a. Cessation of _____, _____ _____.

b. Weakness, _____, _____.

c. Mental _____, _____ gait.

d. _____

e. _____

f. _____

g.

h. _____ collapse

i. Death

2. Temperature can rise dramatically - as high as _____. Above this, damage to the _____ occurs.

3. Treatment is aimed at reducing temperature _____.

a. Total _____ in ice water.

b. Cool with fine _____ or _____.

c. Massage _____ during cooling.

d. Wrap in cool _____ _____ or _____.

e. Get _____ attention.

C. Heat exhaustion (not as severe)

1. Symtoms

a. _____ and _____.

b. Profuse _____.

c. _____, _____ & headache.

d. _____.

2. First Aid

NOTETAKING SHEET 3-4-6N

a. Remove to _____ _____.

b. Give cool _____ _____ (0.1%)

c. Use added salt in diet as a preventative measure.

VI. Cold Casualties

A. Generally result from slowed/impeded _____ _____, and the severity of the injury is directly related to the _____ and _____ of exposure, and other complicating factors such as _____, _____ and _____.

B. Types

1. _____

2. _____

C. Degrees of Cold Injuries

1. First Degree - _____

a. Symptoms

1. _____ and _____

2. _____, _____ and dermatitis

3. _____ and, possibly, a deep _____.

b. Treatment

1. _____ and _____ the victim.

2. Examine for more serious injury.

2. Second Degree - _____ foot and trenchfoot.

a. Immersion foot occurs from exposure to water _____ or less for _____ _____ or more.

b. Trenchfoot results from exposure to _____ _____ for _____ days.

c. Symptoms (similar to both)

1. Affected part _____, tingles and gets _____.

2. _____ and cyanosis

3. _____

4. Intense _____ pain

5. _____ - _____ changes

d. Treatment (same for both)

1. Unless tissue is damaged , _____ is not required.

2. During transport, bandage _____ if possible tissue loss.

3. Do not rupture _____.

4. Seek _____ assistance.

3. Third Degree - _____ _____

a. Occurs after _____ exposure to _____ cold. (_____ F and below).

b. Symptoms

1. Burning, stinging, and _____.

2. _____ or _____ _____ color to affected part.

3. _____ .

4. Deep aching pain.

5. Limitation of _____.

6. Possible subsequent _____ and _____ loss.

c. Treatment

1. Rapid thawing in water _____ to _____F.

2. Allay _____

3. Prevent _____ to injured part.

4. Fourth Degree - _____

a. Occurs after exposure to temperatures below _____F.

b. Symptoms

1. Pallid _____ _____ color of affected part.

2. Skin will not move over _____ prominences.

3. _____ and deep _____.

4. Loss of _____.

5. _____ and _____ loss.

c. Treatment is the same as for _____ _____.

5. Avoid thawing a freezing casualty if the part will be _____ to _____.

VII. Transportation and Personnel Rescue.

A. Types of Stretcher/Litters

1. Neil - Robertson

a. Semi - rigid

b. In use, it _____ _____ patient.

c. Main use is transporting victim out of a _____ space or through a _____ opening.

2. Stokes

a. Rigid, _____ type

b. _____ for injured victim

c. _____ to carry

d. Difficult to get through a hatch or a recompression chamber.

3. Army Litter

a. Rigid, _____

b. Good for field use because of portability.

B. Personnel Rescue in Hazardous Environments.

1. Electrical Shock Victims

a. remove by non-conductive materials; rope, broom/swab handle, belt

b. secure _____

c. Do not come into direct contact with the victim until _____ _____ is secured.

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NOTETAKING SHEET 3-4-9N

2. Toxic Gas or Smoke Casualties

a. Do not enter until _____ or _____ _____.

b. If necessary, use a breathing apparatus.

VIII. Poison wounds and animal bites

A. Snake Bites

1. Try to ascertain type of _____.

2. Use appropriate _____ if available.

3. _____ affected part.

4. Apply a _____ above the bite.

5. Treat for _____.

6. Get to _____ assistance.

B. Animal Bites

1. With mammal bites, the chief concern is _____.

a. _____ the animal alive if possibl

b. Observe _____ days.

c. If animal connot be found, rabies _____ must begin.

2. Non-rabid animal bites can be treated as _____.

a. _____

b. _____

c. Seek medical attention.

NOTETAKING SHEET 3-5-1N

TITLE: Diving Disease/Injury Treatment (Circulatory and Respiratory Systems)

REFERENCES

U.S. Navy Diving Manual, Vol. I

NOTETAKING OUTLINE

I. Circulatory System

A. Anatomy

1. Heart

a. Situated behind _____ _____.

b. Consists of _____ pumps.

1. Pumps blood from the body to the lungs. Known as the pulmonary circuit.

2. Left side pump propels the blood from the _____ out into the _____ (known as the _____ _____)

2. Blood Vessels - carries _____ to the various _____ and _____ through the body.

a. Arteries - _____ _____.

1. Largest Artery -

2. As they get further from the heart, arteries _____ in size and _____ in number.

3. Small arteries - _____ _____.

b. Capillaries are the _____ and most _____ of the blood vessels.

1. All body cells are close to at least _____ _____.

2. Can be as small as the _____ of one red blood cell.

c. Veins are blood vessels that serve to _____ blood to the _____ _____ of the heart.

1. Smallest veins are called _____ which _____

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NOTETAKING SHEET 3-5- 2N

in size and _____ in number going from the capillaries toward the heart.

2. Largest vein: _____ which carries blood directly into the _____ _____ of the heart.

3. Some larger veins have _____ _____ to prevent _____.

3. Blood

a. 4 components

1. _____

2. _____

3. _____

4. _____

b. 50% of the blood is _____, 50% _____(cells and _____).

c. About _____ _____ in the average body.

4. Red blood cells (RBC) - comprise about _____ of total blood volume.

a. Carry most of the _____ to cells and tissues.

b. Transport _____ from cells and tissues to the _____.

c. _____ on the RBC molecule binds with _____ and releases it to the cells where it is utilized in the oxidation of _____ to produce _____ and _____ by the cell.

1. O_2 rich = _____ _____ color - _____.

2. O_2 poor - _____ _____ _____ color - _____.

5. White Blood Cells (WBC)

a. Fight _____

b. Body can _____ _____ White Blood Cells.

c. Normal RBC/WBC ratio is _____.

6. Plasma

a. _____ portion of the blood.

b. _____ the tissues.

c. Vehicle for _____ and _____.

d. Carries other _____ to the cells.

7. Platelets - involved in the _____ process in the blood.

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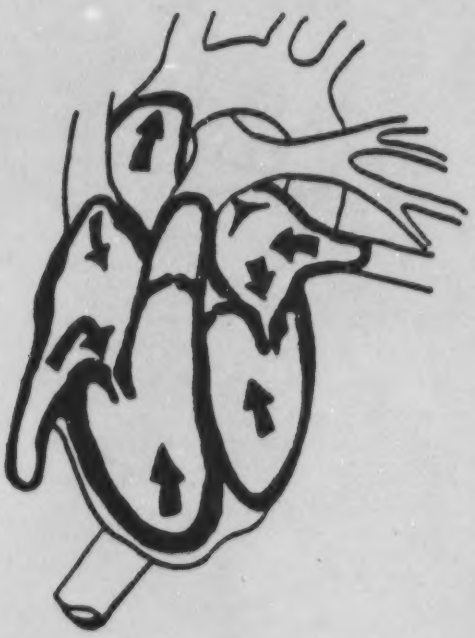
NOTETAKING SHEET 3-5-4N

THE CIRCULATORY SYSTEM



II. Respiratory System

A. Passageway Leading to the lungs.

1. Oral - nasal cavity.

a. Consists of the _____, _____ and _____.

b. Funnel air to lungs, _____ and either _____ or _____ it.

2. Trachea - cartiliginous tube that contains the _____ and directs air into the _____.

a. _____ begins at the bottom of the trachea and branches out into smaller, numerous _____.

1. Become reduced in size until they become _____, which feed air to the _____.

B. The Lungs

1. Divided into _____ containing alveoli.

a. Left lung has _____ lobes.

b. Right lung has _____ lobes.

2. The alveoli is a tiny _____ _____ at the end of the bronchiole.

a. About _____ _____ in the lungs.

b. Present a large surface area to inhaled area.

c. Site of gas _____ and _____.

C. Accessory Organs and Structures

D. Respiratory Physiology

1. Mechanics of Breathing

a. _____, the major breathing muscle, moves _____ and the _____ _____ moves up and outward, creating a _____ _____ in the lungs.

b. Air rushes in to _____ the pressure, _____ the lungs.

c. The _____ relaxes, moves up, and the _____ _____ falls, creating _____ _____, and the air rushes out.

NOTE: ORIGINAL PAGE 3-5-6N HAS BEEN DELETED; HOWEVER ALL MATERIAL HAS BEEN INCLUDED.

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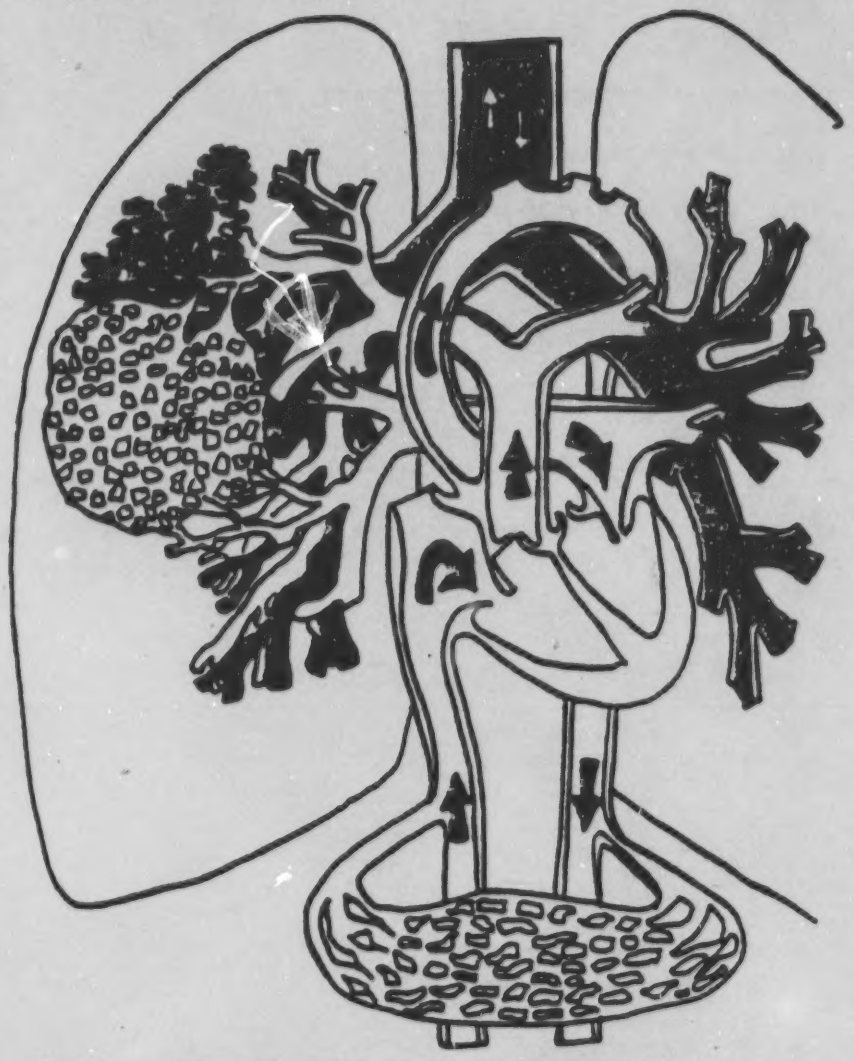
NOTETAKING SHEET 3-5-7N



THE RESPIRATORY SYSTEM

NOTETAKING SHEET 3-5-8N

TITLE: Diving Disease/Injury Treatment (Symptoms, Causes and Preventions.

REFERENCES

U.S. Navy Diving Manual, Vol. I.

Physiology and Medicine of Diving.

NOTETAKING OUTLINE

I. In- water Emergencies

Notetaking Sheet 3-5-77

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NAME OF DISEASE	GENERAL DESCRIPTION
Gas Embolism	

CAUSE

1. _____ that has been trapped during _____.
   a. With sufficient expansion (_____ _____) the gas will rupture the _____ membrane.
   b. _____ _____ escape into the capillary bed that surrounds the _____.
   c. This blood/bubble mixture must go directly to the _____ _____ of the heart, from where the bubbles may travel rapidly to the _____, producing rapid symptoms.

SYMPTOMS

1. Unconsciousness: may occur in or out (within _____ minutes) of water.
2. _____
3. Paralysis or _____ in the extremities.
4. _____ of vision.
5. _____,bloody, frothy, _____.
6. Diver may have felt a "blow to the chest", signifying _____ _____.

TREATMENT

1. Immediate _____ to _____ feet to resolve _____ causing symptoms. Utilize _____, if available.
2. _____ may be required after recompression.

PREVENTION

1. _____ screening of personnel with _____ disease.
2. Proper _____.
3. Evaluation of diver's _____ _____.

_____ _____ _____

OTHER

RULE: Any diver, who has had a source of gas at depth, that surfaces unconscious or becomes unconscious within 5 minutes after arriving on the surface, must be assumed to have gas embolism regardless of any factor that may explain the condition.

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NOTETAKING SHEET 3-5-9N(A)

A. Other Gas Expansion Injuries

There are three injuries other than gas embolism which may result from the expansion of gases trapped in the lungs during ascent. These injuries may appear either alone, or in various combinations with each other and/or gas embolism.

1. Pnuemothorax - rupture of the lung wall

   a. indicated by a complaint of a "blow" to the chest.
   b. allows gas to escape from the lung into the chest cavity.
   c. The gas escaping into the chest cavity may cause difficulty in breathing, and collapse the lung.
   d. chief danger is in the expansion of the trapped gas on ascent FROM A TREATMENT SCHEDULE, making the symptoms more severe. Therefore, treatment of choice is hospitalization, NOT RECOMPRESSION.

2. Mediastinal Emphysema - expanding gases trapped in the middle of the chest, around the heart, the trachea, and major blood vessels.

   a. usual symptoms are a dull ache or tightness under the breastbone, which is made worse by taking a deep breath.
   b. hospitalization is the treatment of choice unless the victim shows signs of gas embolism.

3. Subcutaneous Emphysema - expanding gases in the subcutaneous tissues (skin layers), which rise upward from the chest to the shoulder and neck region.

   a. recognizable by possible swelling and crepitus (a cracking sound).
   b. hospitalization is the treatment of choice unless the victim shows signs of gas embolism.

Notetaking Sheet 3-3-10M

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NAME OF DISEASE	GENERAL DESCRIPTION
Drowning(or near-drowning)	

CAUSE

1. Fatal or near fatal hypoxia caused by:
   a. _____ or over exertion of a swimmer.
   b. Accidental loss of _____ _____.

SYMPTOMS

TREATMENT

1. Restore _____ via _____ (mouth-to-mouth or mechanical)
2. Restore _____ by closed chest _____ _____
3. _____ the victim.

PREVENTION

1. Observe _____ _____.
2. _____ fitness.
3. _____ in proper use of equipment.

OTHER

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Notetaking Sheet 3-3-11N

NAME OF DISEASE	GENERAL DESCRIPTION
Lung Squeeze	

CAUSE

1. Too deep descent during skindive.
2. Breath _____ during descent.
3. Failure of _____ during descent.

SYMPTOMS

1. Sensation of chest _____ during descent.
2. Pain in _____ (sometimes)
3. Difficulty _____ on return to surface.
4. _____, _____ sputum.

TREATMENT

1. Bring diver to _____.
2. Place in _____ position; try to clear _____ from mouth.
3. Give _____ _____ if not breathing.
4. Give _____, if necessary.
5. Get _____ help.

PREVENTION

1. Controlled _____ (not exceeding _____ FPM)
   a. Stop if _____ occurs.
   b. _____ if it fails to clear.
2. Proper _____.

OTHER

Notetaking Sheet 3-5-12N

NAME OF DISEASE	GENERAL DESCRIPTION
Body Squeeze	Results in deep-sea diving dress when the _____ _____ to the diver inside the dress fails to balance the exterior _____ _____.

CAUSE

1. _____ failure or cut air hose and no _____ _____.
2. _____ _____ of diver without compensation.
   a. Tends to _____ diver into helmet and breastplate.

SYMPTOMS

1. More severe: bleeding from nose, lungs or eyes; swelling of tissues of head, neck and shoulders; bleeding into the skin and membranes.
2. Unconsciousness.

TREATMENT

1. Increase _____ _____ in suit.
2. Cold packs for areas of bleeding skin.
3. As for lung squeeze.

PREVENTION

1. Check _____ valve, before each dive.
2. Use volume tank on compressor.
3. Use controlled descent.
4. Take precautions not to fall.

OTHER

1. Such a squeeze producing fall can occur following a _____ with rupture of the dress, if the tender's fail to take in the diver's _____ as he _____

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Notetaking Sheet 3-3-13N

NAME OF DISEASE	GENERAL DESCRIPTION
Middle Ear Squeeze	

CAUSE

1. Result of a blocked _____ _____.
   a. Air space formed between _____ _____(tympanic membrane) and the site of closure in the _____ _____.
   b. Fluid, _____ and _____ fill the space behind the drum to _____ _____.
   c. If descent is not stopped, or _____ not cleared, a _____ ear drum could result.

SYMPTOMS

1. Pain that increases with _____.
2. Ruptured drum could allow a rush of _____ _____ which can cause _____ and momentary nausea.
3. Pain normally stops when _____ _____.

TREATMENT

PREVENTION

1. Ability to _____.
2. Use _____ or _____ before diving.
3. Use controlled _____.
4. _____ dive if necessary.

OTHER

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NAME OF DISEASE	GENERAL DESCRIPTION
External Ear Squeeze	A result of blockage of the external _____ _____.

CAUSE

1. Tight fitting _____ or _____ _____ cause an air pocket in the external _____ _____.

   a. Elevated pressure that is equalized through the _____ _____ creates an area of _____ pressure between the ear plug and drum, forcing the drum _____, and, thus, pain.

SYMPTOMS

1. Pain on descent.
2. Feels much the same as middle ear squeeze.

TREATMENT

PREVENTION

1. Don't wear _____ _____.
2. Vent tight-fitting _____.
3. Assure ability to _____ before diving.

OTHER

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Notetaking Sheet 3-5-15N

NAME OF DISEASE	GENERAL DESCRIPTION
Face Mask Squeeze	

CAUSE

1. Failure to equalize pressure in the SCUBA facemask by _____ _____

2. Loss of _____ _____ or malfunctioning/mishandling of the _____ _____ _____, in Lightweight Diving Equipment.

SYMPTOMS

1. Sensation of _____ applied to face.
2. Pain
3. Inability to _____.

TREATMENT

1. Administer artificial respiration if diver is not breathing.
2. As for Lung Squeeze.
3. Apply cold packs to bruised or bleeding areas.
4. Give sedatives and pain - relieving drugs.

PREVENTION

OTHER

Notetaking Sheet 3-5-16 M

NAME OF DISEASE	GENERAL DESCRIPTION
Suit Squeeze	

CAUSE

1. In dry-suit diving, and air pocket is trapped in the _____ of the suit.

SYMPTOMS

1. Pinching sensation of the skin.
2. As external ear squeeze.

TREATMENT

1. Cold applications where bleeding.
2. As for external ear squeeze.

PREVENTION

1. Equalize suit.
2. Stop descent when pain develops.
3. Equalize by getting air from facemask to go past face seal into hood.

OTHER

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Notetaking Sheet 3-5-17W

NAME OF DISEASE	GENERAL DESCRIPTION
Sinus Squeeze	

CAUSE

Sinuses are _____ _____ located within the bones of the _____, lined with _____ _____ and connected to the _____ _____ through narrow openings (_____). In upper respiratory infections, sinuses may become _____, and the _____ blocked, thus forming air pockets which react to _____. The mucosa swell, filling the cavities with _____ and _____. The pain is intense.

SYMPTOMS

TREATMENT

PREVENTION

1. Halt _____, come up a few feet and clear.
2. Use _____ _____ of descent.
3. Utilize _____ or _____ before diving.

OTHER

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Notetaking Sheet 3-5-18M

NAME OF DISEASE	GENERAL DESCRIPTION
Tooth Squeeze	

CAUSE

1. Improper _____ or _____ pocket in the teeth.

SYMPTOMS

TREATMENT

PREVENTION

1. Inform dentist that you are a diver and to insure against possible air pockets when teeth.

OTHER

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Notetaking Sheet 1-5-19N

NAME OF DISEASE	GENERAL DESCRIPTION
Inert Gas Narcosis	Physical phenomenon exhibited by some inert gases under increased pressure, characterized by an _____ condition in the diver.

CAUSE

SYMPTOMS

1. Increase with depth:
   a. 100' - 150':
   b. 150' - 200':
   c. 200' - 250':
   d. 250' - 300':
   e. 300' - 350':

2. Extreme sleepiness is common.

TREATMENT

PREVENTION

OTHER

1. Depth of occurence is dependent upon specific _____ _____, diver _____, and concentration of _____.

2. Argon has demonstrated increased narcosis tendencies.

3. Helium narcosis has not been seen at even 2000.

Notetaking Sheet 3-5-20N

NAME OF DISEASE	GENERAL DESCRIPTION
Pulmonary Oxygen Toxicity	

CAUSE

1. Prolonged exposure to _____ _____ _____ of oxygen.

   a. High _____ concentration.
   b. Excessive _____ using air.
   c. A combination of the above.

SYMPTOMS

1. Preceeded by a _____ _____ that varies with individuals, _____ and _____ pressure.
2. Occurs at depths of _____ to _____.
3. Physical Symptoms:

   a. _____ irratation
   b. _____ production
   c. _____ damage.

TREATMENT

1. Reduce the _____ _____ of 02.

   a. Remove the _____.

   b. Decrease the _____.

PREVENTION

1. Knowledge of _____.
2. Proper _____.
3. Adherence to _____ _____ _____.

OTHER

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Notetaking Sheet 3-5-21N

NAME OF DISEASE	GENERAL DESCRIPTION
Central Nervous Syetem Toxicity	

CAUSE

1. Same as pulmonary toxicity.
2. Occurs in depths in excess of _____.
3. Normally occurs before _____ _____ are seen.

SYMPTOMS

1. Can be entirely absent or unnoticed and the diver go directly into _____ (_____ _____ seizure).
2. VENTID Acronym:
   - V -
   - E -
   - N -
   - T -
   - I -
   - D -

TREATMENT

1. As for Pulmonary Oxygen Toxicity.
2. For convulsions, reduce the partial pressure and prevent diver from _____ himself.

PREVENTION

1. As for Pulmonary Oxygen Toxicity.

OTHER

Notetaking Sheet 3-5-22N

NAME OF DISEASE	GENERAL DESCRIPTION
Carbon Dioxide Toxicity	1. An _____ of CO2 in the _____.

CAUSE

1. Insufficient _____ _____ in surface supplied air diving and _____ _____ in SCUBA.
2. Increased _____ of CO2 due to _____ _____ on the bottom.
3. Contamination of the _____ _____.
4. Failure of the CO2 _____.
   a. HeO2 - _____
   b. _____ or _____-_____ circuit SCUBAs.

SYMPTOMS

1. Rapid _____ _____.
2. _____.
3. Loss of _____.
5. Death can result from _____ _____.
6. Sign
   a. _____ face plate.

TREATMENT

1. Removal of _____.
2. _____ with O2 in severe cases.
3. Consider a _____ _____.

PREVENTION

OTHER

1. Increased susceptability to _____ _____ and nitrogen narcosis.
2. Danger of initiating _____ _____.

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Notetaking Sheet 3-5- 23N

NAME OF DISEASE	GENERAL DESCRIPTION
Hypoxia	A general term for a condition resulting from a lack of _____ to the tissues; a breakdown in the _____ transport _____; or a _____ failure to use the 02 transported to the tissues.

CAUSE

1. _____ obstruction or restriction.
2. Insufficient _____ in the diver's breathing media.
   a. 02 partial pressure to the diver must be _____ ATM
3. Diseases of the _____.
4. _____ diseases and interference with _____.
5. Toxic conditions within the body tissues.

SYMPTOMS

1. 02 partial pressure of _____ will produce:
   a. _____
   b. _____
   c. Mild _____
   d. Loss of fine _____ _____.
2. Any partial pressure below 0.6 will be rapidly _____.
3. Rapid, _____ pulse; Elevated _____ _____; Rapid _____; Respiratory _____; Pale _____, Blue color in lips, skin and fingernails - _____.

TREATMENT

1. Artificial _____.
2. Maintain _____.
3. Administer _____.
4. Consider _____.

PREVENTION

1. Alertness to conditions and situations capable of depriving the diver of oxygen.

OTHER

NAME OF DISEASE	GENERAL DESCRIPTION
Carbon Monoxide Toxicity	1. Carbon monoxide combines with Hemoglobin in blood and keeps it from carrying Oxygen Insufficient oxygen reaches the tissues.

CAUSE

1. Contamination of diver's air from:
   a. _____ _____ too close to exhaust.
   b. Flashing of _____ _____ in compressor.

SYMPTOMS

1. Frequently _____ noted; _____ without warning.
2. Occasionally have tightness across the _____, _____, _____, nausea and weakness.
3. Confusion and other _____ changes similar to anoxia.

Signs: Failure to respond, clumsiness, bad judgement, and the like may be noted by tender or buddy. Unconsciousness, death, Abnormal redness of _____, _____ or skin.

TREATMENT

1. Fresh _____; _____, if available.
2. Treatment Table _____.

PREVENTION

1. Place exhaust downwind as far from compressor intake as possible.
2. Adequate maintenance and proper operation of compressors.
3. Test air periodically.

OTHER

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Notetaking Sheet 3-5-25N

NAME OF DISEASE	GENERAL DESCRIPTION
Asphyxia	1. Involves both hypoxia and _____ _____ excess

CAUSE

1. Loss or inadequacy of _____ _____.
2. Obstructed _____.

SYMPTOMS

1. As for hypoxia

TREATMENT

Resuscitation coupled with removing causative factors.

PREVENTION

1. Same as for hypoxia

OTHER

II. Decompression Sickness

A. Defined as a condition resulting from insufficient _____ following exposure to _____.

B. Causes of Decompression Sickness

1. At sea level, the human blood and tissue level of nitrogen from the air is about _____ATA (partial pressure).

2. With the application of higher partial pressures of N2, as in diving or hyperbaric chamber activities, more nitrogen is dissolved into the blood and tissues. (_____ Law).

a. Rate of absorbtion dependent upon _____ and _____.

b. Other factors influencing amount of gas absorbed:

1. _____ _____.

2. Diver _____ _____

3. Diver _____ _____

3. As long as the diver remains on the bottom, there is no danger from the bends.

4. Upon ascent, Henry's Law is reversed - the absorbed inert gas in the tissues, has a _____ partial pressure than the circulating gas, and forces the absorbed _____ out of the tissues.

a. Normally exits the body via the _____.

b. In ascent is to rapid, or decompression is omitted, the gas may form _____ in _____.

c. The bubbles can clump together (_____ _____), grow larger and venous flow to the lungs becomes _____.

d. Tends to accelerate the further formation and growth of bubbles, which may then lodge in a _____, starve _____ _____, and cause symptoms.

e. Most common site of bubble location is in the _____.

5. Generally, the seriousness of decompression sickness is dependent upon the _____, _____ and location of the bubbles.

C. Diagnosis

1. Usually occurs shortly after the diver reaches the surface.

a. 50% within _____ _____.

b. 85% within an _____.

c. 95% within _____ _____.

d. 1% delayed more than _____ hours.

2. Frequency of symptoms follow a pattern - although it is almost impossible to predict the onset and location of decompression sickness.

a. Local pain symptoms - _____

1. _____ - 30%

2. _____ - 70%

b. Central Nervous System - _____

1. Dizziness - 5.3%

2. _____ - 2%

3. Chokes (Respiratory Distress) - _____

4. Extreme _____ and pain - 1.3%

5. _____ and _____ - 0.5%

c. Brain involvement in decompression sickness is rare.

3. Since decompression sickness and _____ _____ have many of the same symptoms, the biggest factor seperating the two is _____ of _____.

D. Pain - only Decompression Sickness

1. Progresses from mild to unbearable pain.

2. Feels as if it is the _____ or deep within the _____.

3. Pain is usually _____ by massage or mild movement.

4. Can be aggravated by _____ soaks, _____, _____ or localized _____.

5. Other symptoms

Pain
I _____

S _____
S _____ _____

6. Treatment

a. Do not administer _____.

b. Always resolve and doubt about treatment in favor or _____ _____.

c. Abdominal or Trunk pain is not simple bends.

1. Easily confused with _____ _____.

2. May be _____ involvement, so treat as a _____ _____.

E. Central Nervous System Decompression Sickness.

1. Symptoms

a. Generally include any presented once _____ _____ has been ruled out.

b. May progress to incapacitation or permanent injury.

c. Symptoms include:

1. _____ of muscles

2. _____

3. "_____ and _____" sensation

4. _____

5. _____ disturbances.

a. _____ vision

b. _____ vision

6. Hearing disturbances

a. _____ in the ears

b. Hearing loss

7. _____ and _____

8. Difficulty in _____.

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NOTETAKING SHEET 3-5-29N

2. Treatment - must be started as soon as possible.

a. Involves application of _____, administration of _____ and slow _____.

1. Initial recompression is to: _____

2. Oxygen _____ the blood and tissues.

a. Air treatment may be used only if:

1. 02 is not available

2. Casualty to 02 system during treatment.

3. 02 tolerance test has not been given or victim has trouble with oxygen.

b. General treatment rules:

1. Treat _____

2. If in doubt, _____.

3. Follow _____ _____.

4. Hold diver _____ hours after treatment; _____ hours if prompt return cannot be assured.

III. The Unconscious Diver

A. Three periods of occurence

1. While on the _____.

2. From leaving the _____ to within _____ minutes after surfacing.

3. _____ minutes to _____ hours after reaching the surface.

B. On the Bottom

1. Causes

a. Loss of _____ _____.

b. Hypercapnia

c. _____ _____ toxicity

d. _____ toxicity

e. _____

f. _____

2. Action

a. Deep Sea Gear

1. Try _____ signals, look for _____.

2. Use another diver.

3. Bring diver to 1st stop at _____FPM and attempt to regain communication. If he remains unconscious, consider:

a. _____

b. _____ at depth.

b. SCUBA Diver

1. Bring diver to _____ at 60 FPM.

2. _____ with oxygen or mouth-to-mouth method.

3. Observe for signs of _____ or _____ _____.

c. Light Weight Diving.

1. Same as _____ _____.

C. Unconscious

1. Causes

a. _____ _____

b. Massive _____ _____

c. _____ _____ poisoning

d. _____ _____ poisoning

e. _____

f. _____

2. Treatment

NOTETAKING SHEET 3-5-31N

a. _____ at once to a depth appropriate to the _____ presented.

1. Much safer to treat for the _____ _____ problem, _____ _____.

D. Unconscious 15 minutes to 24 hours after surfacing.

1. Cause

a. Gas _____

b. Central Nervous System _____ _____

c. _____ _____ suffered while on bottom.

2. Gas embolism must be considered as a possibility up to _____ minutes after surfacing.

3. Most likely cause of unconsciousness is _____ _____.

NOTETAKING SHEET 3-5-32N

TITLE: Diver Disease/Injury Treatment (Treatment Tables)

REFERENCES

U.S. Navy Diving Manual, Vol. I
Physiology and Medicine of Diving

NOTETAKING OUTLINE

I. General

A. _____ is the preferred breathing media for treatments requiring recompression.

1. 10 yrs research

2. _____Treatment Tables have a high rate of failure.

3. Two Phase Treatment Approach

a. Initial _____ to eliminate or reduce _____.

b. Removal of all absorbed _____ _____ by slow _____.

c. The oxygen Tables feature the return to _____ for use of oxygen.

1. Eliminates additional inert gas _____ or _____.

2. Increases outward _____ _____ gradient of tissue and blood inert gas.

3. Encourages normal elimination of dissolved gases.

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NOTETAKING SHEET 3-5-3W

Oxygen Breathing Treatment Tables

Table 3 - _____ Minutes

1. Used for: _____
   _____.

2. Start Oxygen breathing: _____.

3. Descent rate: _____.

4. Oxygen Breathing Time: Two _____ minutes periods separated by _____ minutes of _____.

5. If Oxygen Toxicity develops:

   a. Remove the mask, wait for all symptoms to _____.

   b. Wait an additional _____ minutes.

   c. Resume schedule at point: _____

   d. Repeat, as necessary.

6. Rate of Ascent: _____

7. If Patient displayed 02 Symptoms at 60', upon arrival at 30', utilize the _____ _____ for Table _____.

8. Travel from 30'to surface: _____

9. Retain patient near chamber for _____ _____.

10. Tenders used during treatment

    a. Must be _____ _____ or _____ Class Diver.

    b. Tender breaths: _____
       _____.

NOTETAKING SHEET 3-5-34N

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Oxygen Breathing Treatment Tables

Table 6 - _____ minutes

1. Used for:

   a. _____
   _____.

   b. _____
   _____.

2. Descent Time: _____

3. Start breathing Oxygen: _____

4. Handle Oxygen Toxicity Symptoms: _____

5. Ascent time: _____

6. Rules for tenders: _____

7. Table 6 may be lengthened:

   a. _____

   b. _____

   c. _____

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NOTETAKING SHEET 3-5-35N

Oxygen Breathing Treatment Table

Table 5A - _____ minutes

1. Used for: _____
   _____.

2. Rate of Descent: _____

3. Remain at 165' for _____ minutes.

   a. All symptoms must be clear before selecting Table 5A.

4. Ascend from 165' to 60': _____
   _____.

   a. At 60': _____

5. From 60' to 30' and from 30' to surface: _____

6. 02 Toxicity Symptoms

   a. Same as for Table _____

   b. Switch to _____ at 30' for any 02 symptoms encountered at 60' on 5A.

7. Tenders follow same rules as for Table 5.

NOTETAKING SHEET 3-5-36N

Oxygen Breathing Treatment Table

Table 6A - _____ minutes

1. Used for: _____
_____.

2. Rate of descent: _____

3. Symptoms must show positive signs of clearing prior to _____ minutes at 165'.

   a. No moderation of symptoms commits patient to Table _____.

4. Rate of ascent:

   a. 165' to 60'" _____

   b 1. Upon arrival at 60', go on oxygen.

   b. Remainder of treatment is as Table 6.

5. Tenders - same procedures/rules as Table 5.

6. Oxygen Toxicity Symptoms as for Table 5

7. Table may be lengthened.

   a. _____ minutes 02 and _____ minutes air at _____ feet.

   b. _____ minutes 02 and _____ minutes air at _____ feet.

   c. Either or both may be used as necessary.

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NOTETAKING SHEET 3-5-37N

II. Air Treatment Tables

A. General

1. Not effective in treating _____ _____ or _____ _____.

2. Use in place of oxygen only if:

a. Patient is known to tolerate oxygen _____.

b. Patient has not had: _____

c. Failure of Oxygen system during treatment.

d. _____ treatment

e. Treatments when 02 therapy have failed to relieved _____.

3. Table selection depends upon _____.

a. Pain only bends

1. Selection depends upon _____ of relief.

NOTETAKING SHEET 3-5-38N

Air Breathing Treatment Tables

Table 1A - _____ _____ _____

1. Depth of relief: _____

2. Descent rate: _____

3. Ascent rate: _____

4. Time at 100': _____

5. Also used for _____ _____

6. Not used for _____ _____

NOTETAKING SHEET 3-5-39N

Air Breathing Treatment Tables

Table 2A - _____ _____ _____

1. Treatment depth: _____

2. Descent rate: _____

3. Ascent rate: _____

4. Time at 165' includes _____ time.

5. Not used for _____ _____.

6. Used when symptoms do not clear prior to _____ feet.

7. If pain only symptoms are not relieved after _____ minutes at 165', complete Table 2A.

   a. Do not extend time at _____.

b. Patient may not have decompression sickness.

c. There may be _____ or permanent _____ causing the pain.

NOTETAKING SHEET 3-5- 40N

Air Breathing Treatment Tables

Table 3 - Serious _____ or gas _____.

1. Treatment depth: _____

2. Descent rate: _____

3. Ascent rate: _____

4. Used if symptoms are relieved within _____ minutes at 165'.

5. Time at 165' includes _____ _____.

6. Symptoms not relieved after 30 minutes at 165', use _____ _____.

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NOTETAKING SHEET 3-5-41N

Air Breathing Treatment Tables

Table 4 - Serious _____ or gas _____.

1. Treatment depth: _____

2. Descent rate: _____

3. Ascent rate: _____

4. Time at 165' includes descent time.

5. Time spent at 165' is _____.

   a. Must be at least _____ minutes.

   b. Must not exceed _____ minutes.

   c. Patient may be brought up after minimum time, providing _____ is _____.

6. If symptoms are not relieved, or relief is incomplete after _____ minutes, bring patient out on Table _____.

   a. May not have bends.

   b. May have permanent damage that will not benefit by more time at 165'.

NOTETAKING SHEET 3-5-42N

III. Omitted Decompression

A. Occurs when the diver surfaces faster than _____FPM, missing scheduled _____ _____.

1. Could be caused by:

a. _____

b. Loss of _____ _____.

c. Injured or unconscious diver.

B. Procedures

1. On a dive requiring decompression stops:

b. Use Table _____.

c. Use Table 1A if _____ is not available.

d. Observe diver for symptoms of the _____.

2. If the diver has symptoms upon arrival, treat him accordingly.

3. If no chamber is available, use Table _____ in the _____.

a. _____ treatment is the last resort.

b. Seek the nearest _____.

4. If water depth is insufficient for Table 1A:

a. Use standard air decompression table for _____ and _____ of dive.

b. Repeat all stops deeper than _____ feet.

c. Take _____ minute between stops.

d. At 40' remain _____ of _____ stop time.

e. At 30' remain for _____ of _____ stop time.

NOTETAKING SHEET 3-5-43N

f. At 20' remain for _____ of _____ stop time.

g. At 10' remain for _____ of _____ stop time.

5. Use _____ _____ _____(MkV)

IV. Use of Helium - Oxygen Mixtures in Treatment for HeO2 diving only.

A. Desirable when:

1. Symptoms are _____ to _____.

2. Patient has difficulty _____.

B. HeO2 mix may be used in place of _____.

C. Use _____ mix only.

V. Recurrences - the _____ of any _____ including new symptoms of decompression sickness or gas embolism, either during or after treatment.

A. General

1. Considered evidence that original treatment was _____.

a. Wrong _____ selection.

b. Wrong _____ on Table selected.

c. Possible error in _____.

1. _____ in reporting symptoms.

2. Failure to report _____ _____.

3. Failure to recognize _____ symptoms.

4. Delay in starting.

5. Failure to treat _____.

2. Recurrances are rare in the Navy.

A. Physical condition of divers.

B. Training

C. Activities conducted in proximity of adequate treatment facilities.

B. Management of Recurrances

NOTETAKING SHEET 3-5-44N

1. 02 available, treat _____ recurrences, during and after treatment, on Table _____.

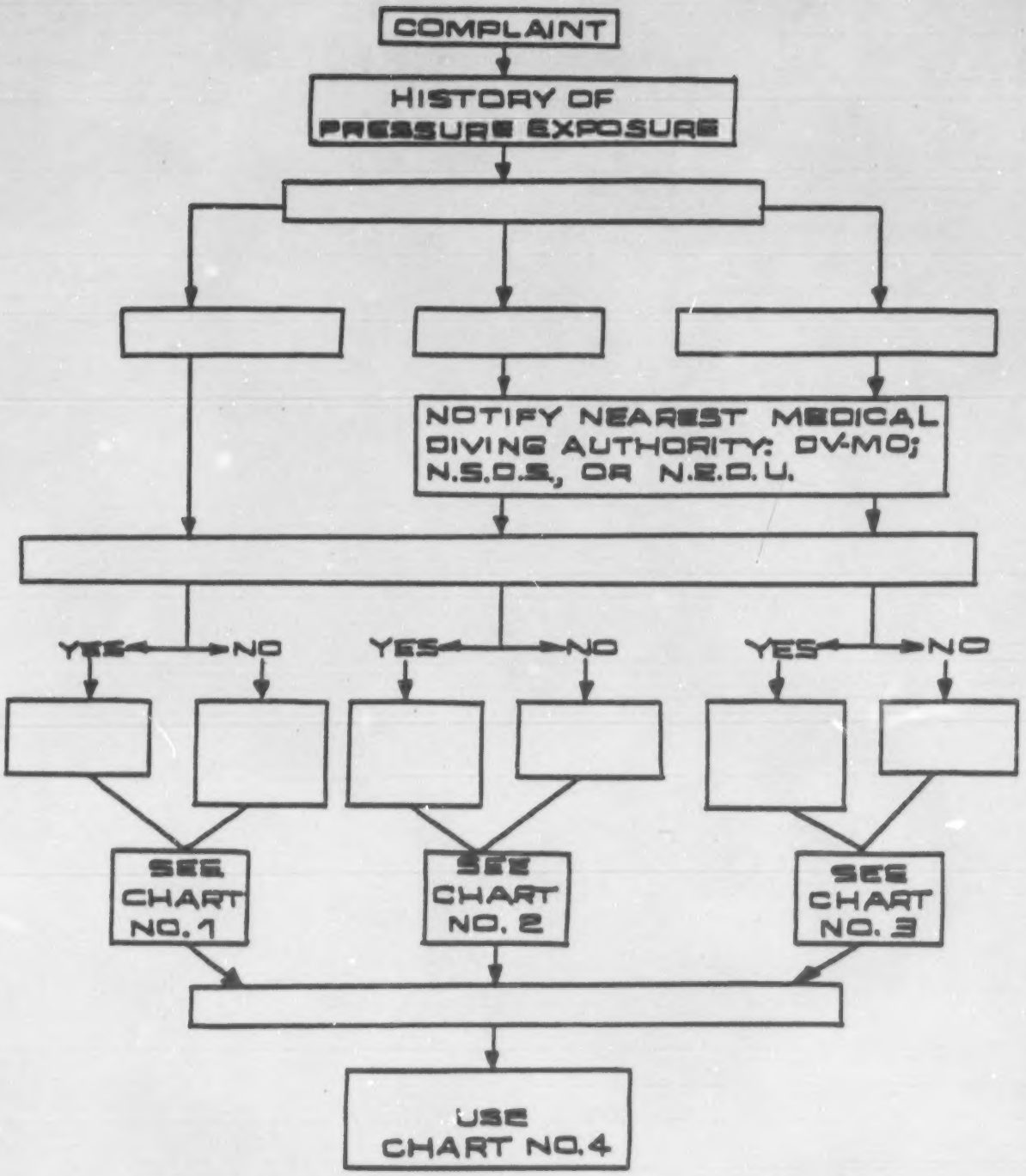
2. 02 not available, treat on Table _____, based on _____ of onset.

   a. Recurrence during treatment - go to _____, use full Table _____.

   b. Recurrence following treatment - go to _____ or _____ (165' maximum) and bring patient out on Table _____ from that point.

3. Bring patient out on Table 6 (or 4) regardless of _____ of symptoms. Further delay in getting the patient hospitalized is detrimental.

4. Do not take patient from Table 6 to Table 4 to treat _____ recurrence.


COMPLAINT
HISTORY OF PRESSURE EXPOSURE
NOTIFY NEAREST MEDICAL DIVING AUTHORITY: OV-MO; N.S.D.S., OR N.E.D.U.
YES
NO
YES
NO
YES
NO
SEE CHART NO. 1
SEE CHART NO. 2
SEE CHART NO. 3
USE CHART NO. 4

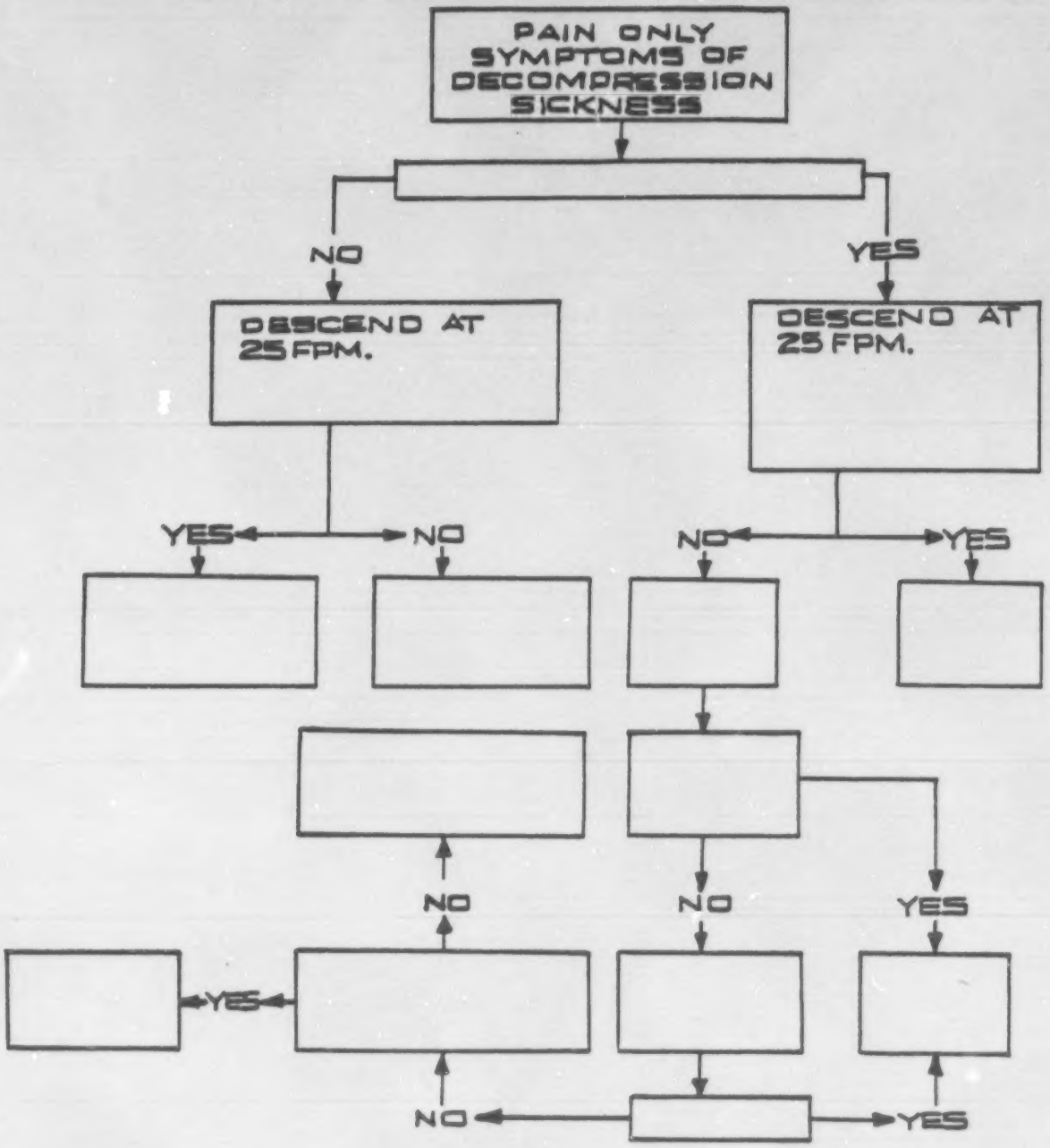

PAIN ONLY SYMPTOMS OF DECOMPRESSION SICKNESS
NO
YES
DESCEND AT 25 FPM.
DESCEND AT 25 FPM.
YES
NO
NO
YES
NO
NO
YES
YES
NO
YES

CHART 1

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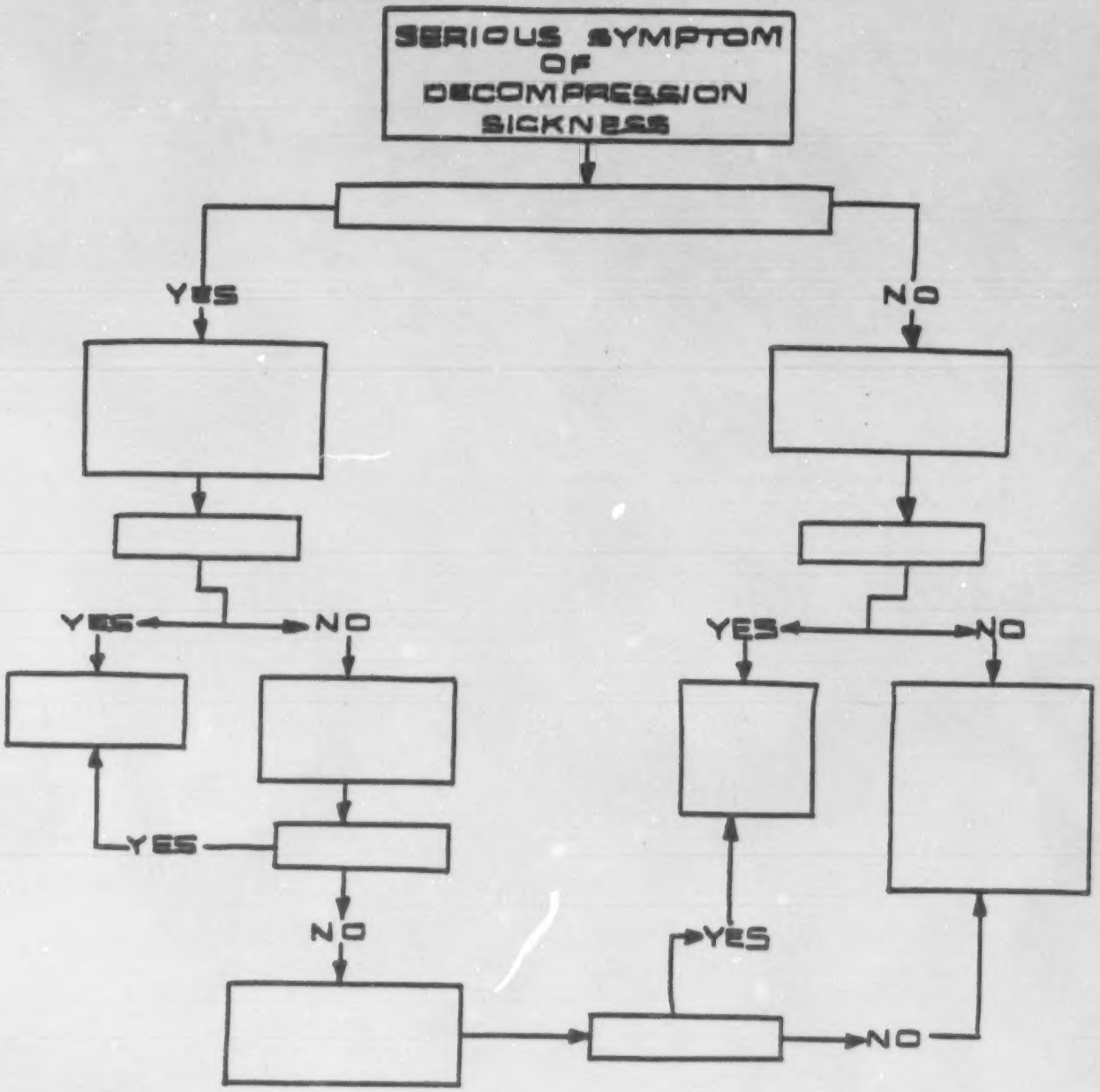

SERIOUS SYMPTOM OF DECOMPRESSION SICKNESS
YES
NO
YES
NO
YES
NO
YES
NO
YES
NO

CHART 2

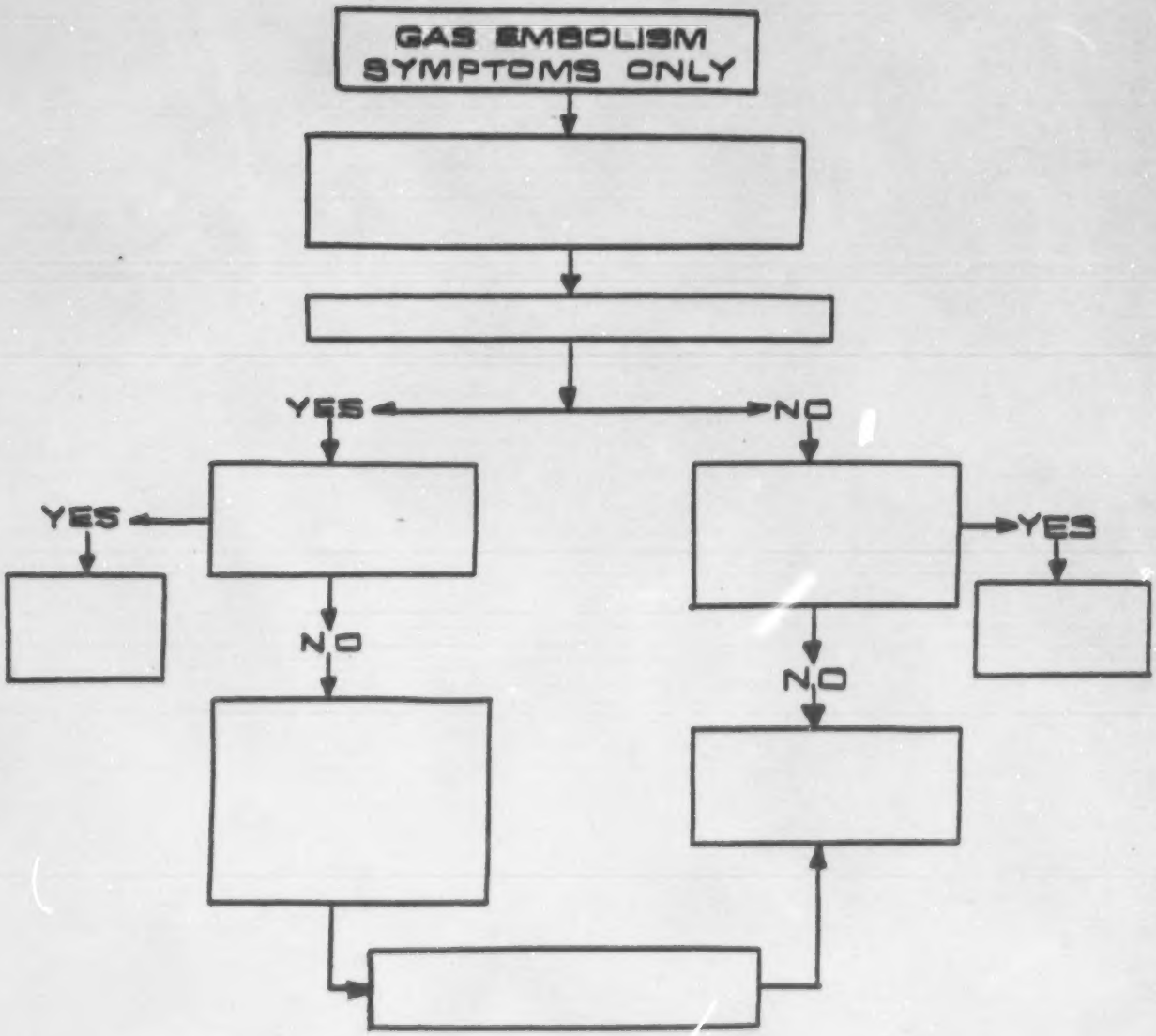


CHART 3

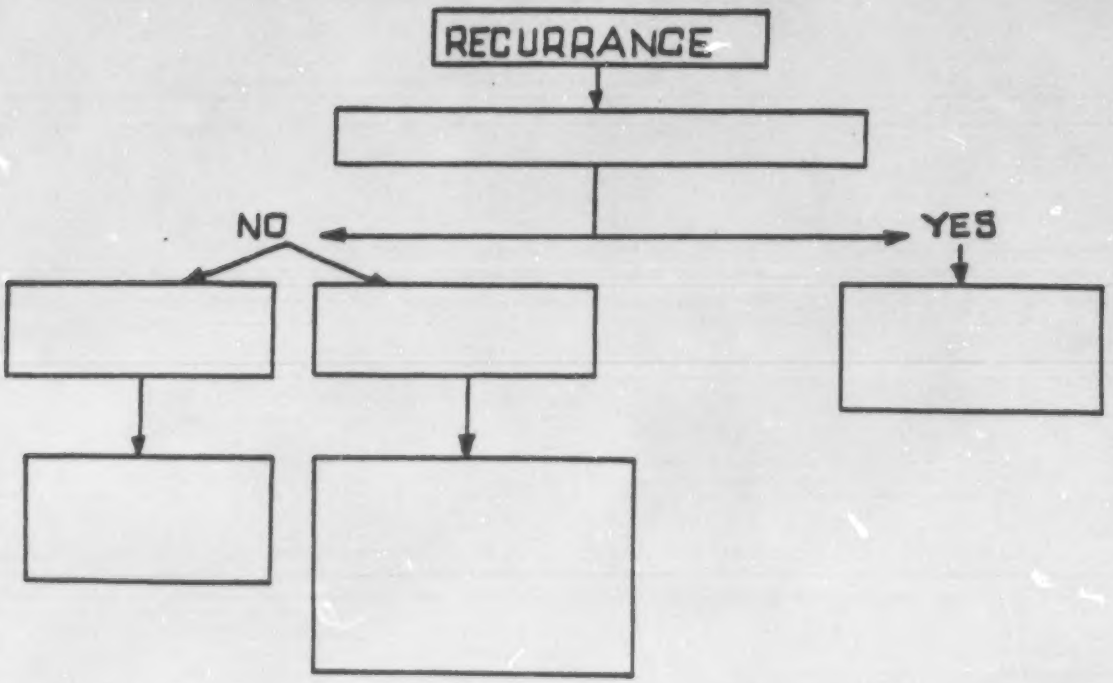
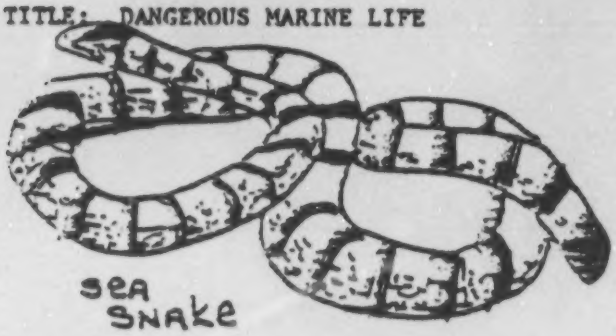


CHART 4

NOTETAKING SHEET 3-6-1N

TITLE: DANGEROUS MARINE LIFE



REFERENCES

U.S. Navy Diving Manual, Vol. I
NVCTP324, Handbook of Dangerous Animals for Field Personnel
Poisonous and Venomous Marine Animals

NOTETAKING OUTLINE

I. Sea Snakes

A. General

1. Over _____ species identified.

a. All are _____.

2. Usually found in western _____, but one species ranges from East Africa to _____ and Central America.

3. To date, none have been found in the _____ _____ or Mediterranean.

B. Physical Characteristics

1. Flat _____ - like tail.

2. _____ _____ and must surface.

3. Usually _____.

4. Extremely _____.

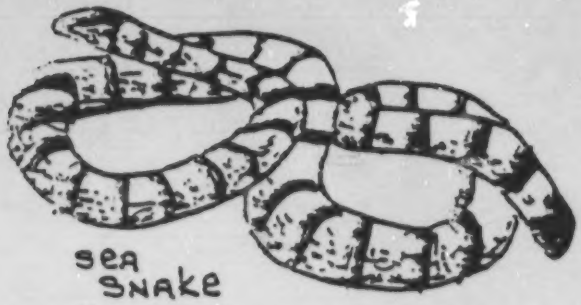
5. Very few species are _____.

C. Symptoms of Bite

1. 1/2 - 1 Hour - _____

2. 1 - 2 Hours - _____

NOTETAKING SHEET 3-6-2N



3. Change in victims _____ color due to destrcution of _____ _____ _____.

4. _____

5. _____ Collapse

6. Death

D. First Aid

1. _____ the victim and the affected part.

2. Apply _____.

3. _____/_____ the snake, if possible

4. About _____ of those bitten show symptoms. Wait _____ _____ before beginning antivenom therapy.

5. Get _____ attention immediately.

NOTETAKING SHEET 3-6-3N

II. Sharks

A. General

1. _____ species, of which _____ are known dangerous.

2. Exists in _____ oceans and _____, attacks are predominate in waters between _____ and _____ latitudes (water temperature _____).

B. More Dangerous Species

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. Hammerhead

C. Precautions to Avoid Contact

1. _____ repellants: marginally effective.

2. Wear _____, _____-_____ clothing or clothing that does not resemble the shark's natural food of the area.

3. _____ _____, a bag-like container has proven most effective.

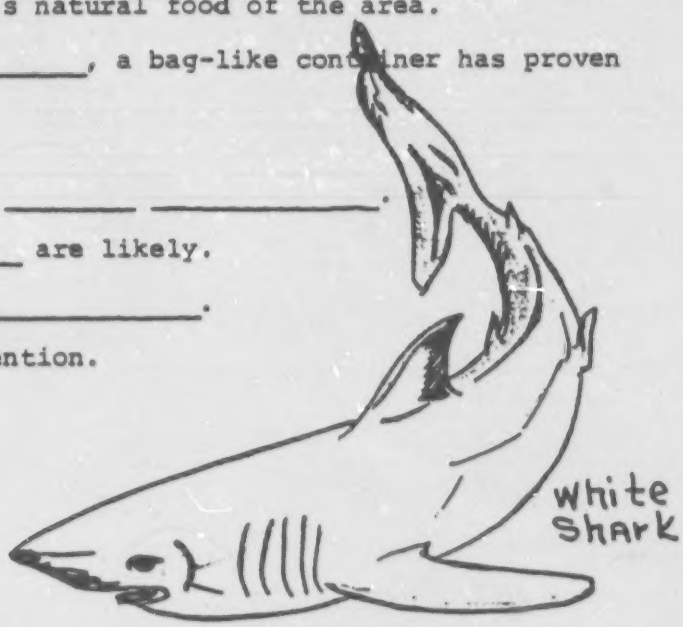
D. First Aid

1. Handle as for a _____ _____.

2. _____ are likely.

3. Treat for _____.

4. Get medical attention.



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NOTETAKING SHEET 3-6-4N

Cone Shell

III. Cone Shells

A. Several species have caused death.

1. Conus Geographicus - _____
_____.

2. Conus Striatus - _____
_____.

3. Conus Textile - _____
_____.

B. Location

1. _____ - _____ area

2. Primarily _____ or _____ inhabitants.

C. Symptoms

1. Similar to _____/_____ _____.

2. _____ around mouth.

3. _____ paralysis

4. Total _____ paralysis

5. _____ collapse

6. Death

D. First Aid

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1. Mostly _____

2. No _____ available.

3. Treat for _____.

Cone Shell

NOTETAKING SHEET 3-6-5N

4. _____ respiration.

5. Get medical attention.

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NOTETAKING SHEET 3-6-6N

Scorpionfish

IV. Poisonous Marine Life

A. Methods of Poisoning (toxification)

1. _____ of poisonous flesh.

b. _____ species involved.

c. Certain fish may be dangerous to eat only: _____.

1. Many marine animals also.

a. _____ _____

b. _____, _____ and _____ _____.

c. Certain _____ species.

2. Mechanical Poisoning

a. Usually a result of _____ _____ or near the animal.

b. Usually the poison is a _____ weapon of the animal.

1. _____

2. _____ _____

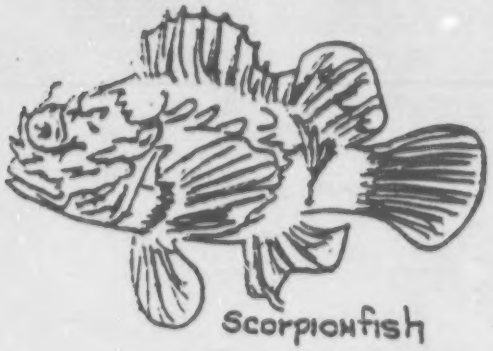
c. Certain animals can inflict painful wounds by just brushing against them.

1. _____ _____

2. _____

B. Poisonous Fish

NOTETAKING SHEET 3-6-7N



Scorpionfish

1. Many species are capable of poisoning humans, usually through _____ at the base of _____ projecting from the _____.

   a. _____ fish

   b. _____ fish

   c. _____ fish

   d. _____ fish

   e. _____ fish

   f. _____ fish

   g. Some species of _____.

. Others have poisonous _____ secretions that may render their _____ or _____ dangerous to humans.

   a. _____

   b. _____ _____

   c. _____

   d. _____ fish

3. Treatment of this type of toxicity consists of:

   a. _____ _____ soaks to delay absorbtion.

   b. Apply _____, if severe case.

   c. Treat for _____.

   d. Get medical attention.

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NOTETAKING SHEET 3-6-88

C. Stingrays

1. General

a. Bury themselves in _____, _____ bottoms.

b. Most victims are _____ who step on the ray and are _____ in the lower leg or foot.

2. Symptoms

a. _____ or _____

b. Pale, _____ skin, later _____.

c. _____

d. Severe pain

e. _____, diarrhea.

f. Muscle paralysis and _____ (Rare)

3. First Aid

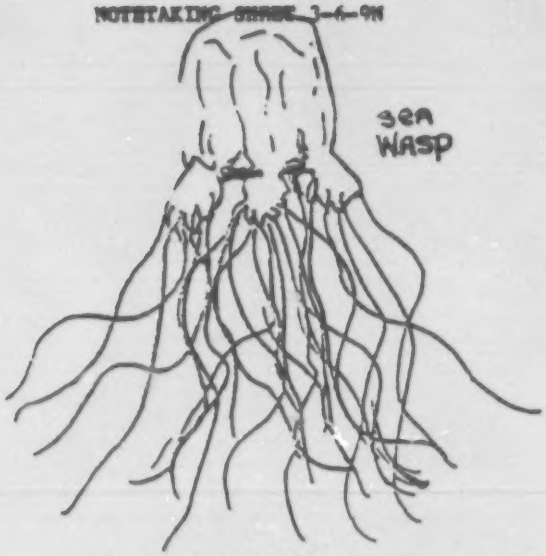
a. Do not remove barb.

b. _____ affected part

c. Apply _____

d. Treat for _____.

e. Transport victim to medical attention.



D. Jellyfish - A general term applied to several species

1. _____ species can be harmful and a few have caused fatalities.

   a. _____ _____

   b. Portugese _____ - ___ - _____

   c. Various _____

   d. _____ _____

2. Mechanism of invenomation is via many small stinging cells contained in the long trailing _____ that come in contact with the victim and poison on contact.

3. Found in _____ waters.

4. Portugese Man - of - War has an inflated bladder that floats and the tentacles may trail _____ _____.

5. Symptoms - general pattern.

   a. _____, _____ sensation.

   b. _____ _____, which may form blisters, at points of contact with tentacles.

   c. _____ and _____ cramps

   d. _____ rigidity

   e. Loss of _____ of _____ and temperature.

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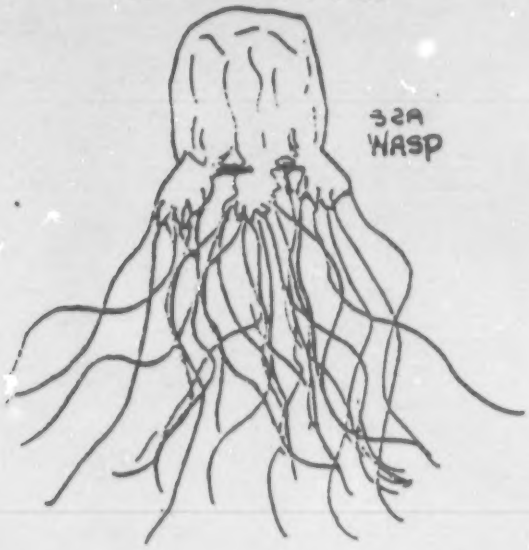
NOTETAKING SHEET 3-6-10M



f. _____, _____.

g. _____ distress.

h. _____, _____, and Death.

6. First Aid - no specific antecdote.

a. Vinegar, tea, isopropyl alcohol may provide temporary relief.

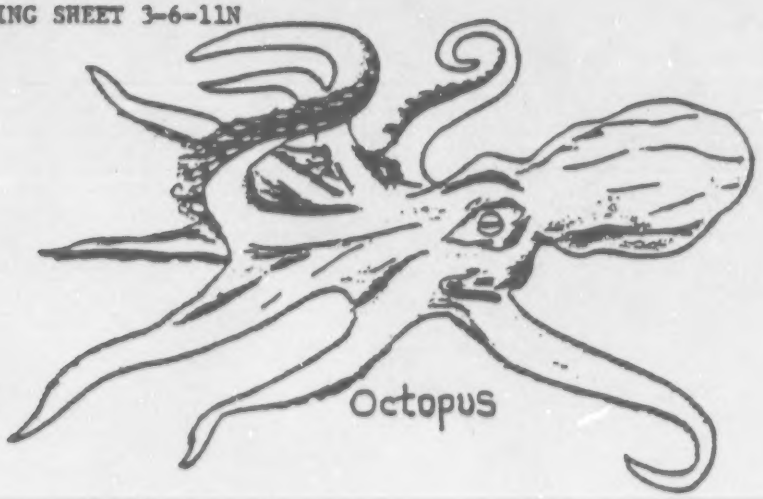
b. Meat _____

c. _____

d. Treat for _____

e. Get to medical attention.

NOTETAKING SHEET 3-6-11N



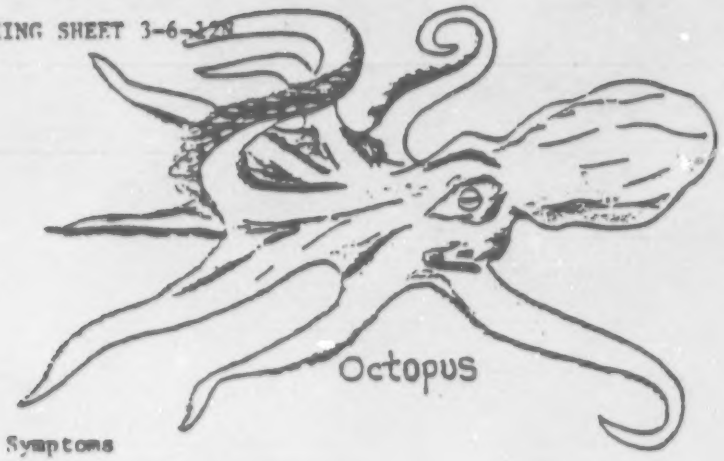
E. Poisonous Coral

1. A few varieties are known to inflict painful stings in victims that merely touch or brush against them.
2. Wounds are _____ to heal.
3. Varieties
   a. _____ _____
   b. _____ _____ _____
4. Symptoms
   a. immediate _____ sensation
   b. _____ formation
   c. _____ _____
5. Left untreated, wound may _____ _____, and _____ arise.
6. Pain is often out of proportion to the injury.
7. First Aid
   a. _____ wound with antiseptic.
   b. Get medical attention.

F. Sea Urchins

1. About _____ species that possess a venomous apparatus.
2. Prevention - <u>don't</u> handle sea urchins
3. Found in almost _____ oceans, but especially _____ seas.

NOTETAKING SHEET 3-6-17N



4. Symptoms

a. Intense burning and _____.
b. Partial _____ paralysis
d. _____ distress
c. General _____ up to _____ hours.
e. Some _____ have been reported.

5. First Aid

a. Mostly _____.
b. Do not attempt to remove _____.
c. Remove victim to medical aid.

G. Octopus

1. Most species possess a venom apparatus in their _____ _____.

2. Inhbbit almost all oceans.

3. Normaliy shy and _____.

a. Most bites occur as a result of + _____.

4. Most bites are _____ in nature producing following symptoms:

a. _____ sensation
b. _____ and _____
c. _____ of mouth and tongue
d. _____ vision
e. Complete _____ _____ of arms and legs in a few cases.
f. Healing is _____ and _____.

5. First Aid

a. Thoroughly _____ wound.
b. Get medical attention.

BARRACUDA

H. Barnacles and Mussels

1. Barnacles will grow on almost _____ _____ _____ _____ _____.
2. Should provide protection from cuts (wet suits).
   a. _____ cuts carefully to avoid infection.
3. Mussels can also _____ a diver easily and, at certain times of the year, they can be _____ to eat.

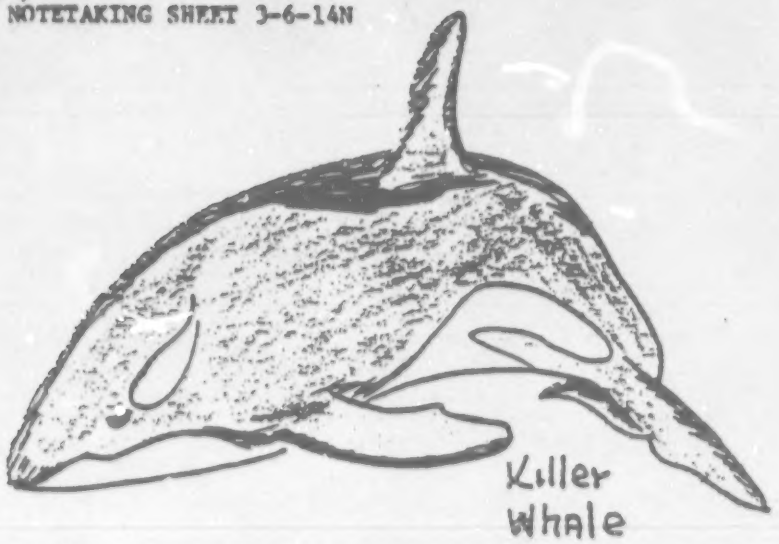
I. Giant Clams

1. Found in _____ or _____ _____ waters.
2. May weigh _____ pounds.
3. Been known to trap divers by closing halves on a hand or foot.
4. Victim may be released by _____ _____ that holds the halves together.

J. Barracuda

1. Found in all _____ and _____ waters.
2. _____ can bite, but the _____ barracuda is most dangerous.
3. Bite is usually straight line _____ type of _____.
4. Attracted by anything entering the water. Extremely _____ fish.
   a. Most likely strike _____ _____ objects.
5. Handle bites the same as _____ bites.

NOTETAKING SHEET 3-6-14N



K. Groupers - Sea Bass

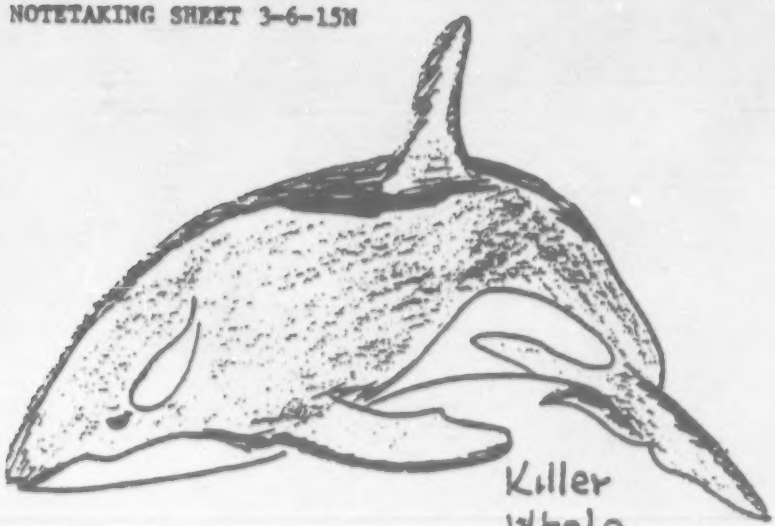
1. Present a hazard because of _____.
2. Inhabit tropical and subtropical waters.
3. Bold, very _____ and ravenous feeders.
4. Handle as for _____ bites.

L. Moray Eels

1. Large, viscious eel.
2. Extremely powerful jaws inflict a _____ bite that may not be _____ until eel is killed.
3. Hide in crevices, _____ _____ and bottom _____.
4. _____ attack if provoked.
5. Treat as for _____ bite.

M. Killer Whales

1. Large, _____ and _____ mammal.
2. Inhabits all oceans but prefers _____ _____.
3. No record of _____ attack.
4. Known to travel in _____.
5. If sighted, _____ water.



N. Sea Lions

1. Large mammals normally found in _____ climates.
2. Very curious, _____ and _____.
3. Have been known to _____ at swimmers/divers during their _____ season.
4. Avoid contact during _____ _____ or if _____ are in the water.

STUDENT GUIDE

FOR

DIVER, SECOND CLASS (A-433-0022)

MEDICAL DEEP SEA DIVING TECHNICIAN (A-433-0020)

SHIP SALVAGE DIVING OFFICER (A-4N-0011)

DEEP SEA (He-O_2) DIVING OFFICER (A-4N-0010)

VOLUME E-F

SCUBA

PREPARED BY

NAVAL SCHOOL DIVING AND SALVAGE

PREPARED FOR

SERVSCOLCOM, SDIEGO

SUBTRACENPAC, PHARBOR

NAVSCOLDIVSAL, WASH

31 OCTOBER 1975

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INFORMATION SHEET 4-1-1I

TITLE: SCUBA Theory

INTRODUCTION

This information sheet, assignment sheet and notetaking outline will provide you with essential information in your introductory phase of SCUBA Diving. A thorough understanding of the information contained herein will aid the student in planning SCUBA dives, using visual hand signals and familarize you with some of the general safety precautions applicable to SCUBA Diving.

SCUBA Diving is, for a variety of reasons, the most dangerous form of diving engaged in by the U.S.Navy. It is imperative that you, the new student, appreciate and respect this face and adhere to the safety procedures/practices taught during this unit.

REFERENCES

U.S.Navy Diving Manual, Volume 1

ASSIGNMENT SHEET 4-1-1A

TITLE: SCUBA Theory

LESSON TOPIC OBJECTIVES

Terminal Objectives
Partial attainment of the following:

1. When the student completes this course he will be able to demonstrate, without error, all visual signals used while diving open circuit SCUBA.

2. When the student completes this course he will be able to, given a typical fleet SCUBA diving task, illustrate proper planning procedures by outlining steps necessary for a successful completion of the task.

3. When the student completes this course he will be able to demonstrate a knowledge and understanding of safety precautions applicable to the open circuit SCUBA diving training activites.

Enabling Objectives
1. List all visual signals used when diving open circuit SCUBA.

2. Define, in writing, all visual signals used when diving open circuit SCUBA.

3. Use appropriate visual signals during diving training activities using open circuit SCUBA.

4. Orally state the main advantages and disadvantages of using open circuit SCUBA.

5. Orally describe the application and/or use of open circuit SCUBA diving.

6. Define, orally and in writing, terms used in open circuit SCUBA diving.

7. Orally state the most common and second most common diving accidents in the use of open circuit SCUBA.

8. Orally describe the minimum number of personnel required when diving open circuit SCUBA.

9. Orally describe normal and maximum working depth limitations for open circuit SCUBA.

10. Orally describe the reasons for using the Buddy System when diving open circuit SCUBA.

11. Orally describe the safety precautions to be followed when: dressing the diver, during the dive, and decompression, as they apply to open circuit SCUBA.

ASSIGNMENT SHEET 4-1-2A 372

STUDY ASSIGNMENT

USS.Navy Diving Manual, Volume I, Figure 5-43 and paragraphs 5.3.3, 5.3.3.4, 5.3.3.5, 5.3.3.6, and 5.3.6

STUDY QUESTIONS

1. The SCUBA diver must always remember that:

   a. his _____ time is limited.

   b. his _____ supply is limited.

   c. he has certain assigned _____ which must be accomplished if

_____ _____ _____.

2. The greatest single safety factor in Navy SCUBA operations is:

   a. the Planned Maintenance System
   b. proper use of the equipment
   c. the buddy system
   d. a well trained diver

3. When SCUBA Diving with a buddy, in good visibility, keep him in sight.

In poor visibility, use _____ _____ _____.

4. Failure of a buddy to respond to a signal must be considered an

_____.

5. Never leave a buddy unless he has become trapped or entangled and cannot be freed without additional assistance. If surface assistance must be sought,

mark the _____ of the distressed diver with a _____

and _____.

6. If one member of a buddy pair aborts a dive, the other member will

_____ _____.

7. The primary means of communications for open circuit SCUBA diving is by

_____ _____.

8. Whenever possible, SCUBA operations will be conducted so that no

_____ is required.

INFORMATION SHEET 4-2-II

TITLE: SCUBA Inspection and Maintenance Procedures

INTRODUCTION

Each diver should know and be able to maintain his own equipment. This is true of all types of diving. The diver who doesn't know how his equipment functions or neglects the regular maintenance of his equipment is headed for disaster. Either his gear will fail because of neglect, thus causing injury or death, or he will find himself in a situation dependent upon his knowledge of his system, and it won't be there. This too could cause a death. Equally important to knowing what to do and when to do it is "how to do it". Equipment "Jury Rigged" to work because proper parts weren't available is just as dangerous as not accomplishing the work at all.

This particular lesson topic, then, is very important and should receive your utmost attention. Literally - what you learn here may save your life.

REFERENCE

U.S.Navy Diving Manual, Volume I
NAVSHIPS INST. 9940.16A
NAVSHIPS 0994-008-0100
NAVSHIPS 394-0065

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ASSIGNMENT SHEET 4-2-1A

TITLE: Open Circuit SCUBA Inspection and Maintenance Procedures

LESSON TOPIC OBJECTIVES

Terminal Objective

1. When the student completes this course he will be able to demonstrate proper inspection and maintenance procedures (in accordance with Planned Maintenance System requirements) for the following open circuit SCUBA equipment and related underwater accessories: Open Circuit SCUBA Cylinder and Manifold Assembly, Single Hose Regulator, Double Hose Regulator, Life Jacket, Diver's Light and Wet Suit.

Enabling Objectives

1. Orally explain the function(s) of each component and the component parts for each piece of equipment and underwater accessory.

2. Given a standard print of each component, show the physical location of each component and component part.

3. List, in writing, the major materials used, explaining why, for each component and selected component parts.

4. List, orally, the protective device(s) found on the open circuit SCUBA cylinders and manifold assembly, single hose regulator and double hose regulator, and life jacket and describe the protection provided by each.

5. Orally list the position(s) and function(s) of each position for the Air Reserve assembly and Block/Shut Off Valve of the cylinder and manifold assembly system.

6. Orally describe the nominal pipe or valve size for the elbow assembly system.

7. Given a standard print of the components, describe, orally, the flow path of the breathing media through the cylinder and manifold assembly and single/double hose regulator systems.

8. For cylinder operating pressure, reserve air supply, safety discs and plugs, and over bottom pressure, state, orally, the major parameters and reasons for them, in terms of effects of operating above/below them.

9. Orally describe the interrelation of the systems.

10. Orally describe inspection/maintenance procedures for each component part within each piece of equipment.

11. Perform, under instructor guidance, inspection/maintenance (in accordance with Planned Maintenance System Requirements) on the equipment listed in the Terminal Objective so that it may be used in open circuit SCUBA diving training activities.

NOTE: ASSIGNMENT SHEET 4-2-2A HAS BEEN DELETED; HOWEVER ALL MATERIAL HAS BEEN INCLUDED.

ASSIGNMENT SHEET 4-2-3A

TITLE: Open Circuit SCUBA Underwater Accessories

STUDY ASSIGNMENT

U.S.Navy Diving Manual, Volume I, para. 5.1.1.2, 5.1.1.3, 5.1.1.4, 5.1.1.5, 5.1.1.6, 5.1.1.7, 5.1.1.8, and 5.1.2

STUDY QUESTIONS

1. The two functions of the face mask are:

   a.

   b.

2. One firm requirement to be met by <u>any</u> face mask is:

3. Define the following, as they apply to SCUBA facemasks:

   a. One-way purge valve:

   b. Indents:

4. The principle function of the life vest (preserver) is:

5. The Modified UDT Life Preserver is designed for use primarily:

6. The Mk III Life Preserver has a lifting capacity of _____ pounds at _____ feet.

7. Care must be taken to ensure that the proper _____ have been installed in the life preserver.

8. A SCUBA unit with full tanks tends to have _____ buoyancy.

9. What are the three standards for weight belts used in SCUBA?

   a.

   b.

   c.

 ASSIGNMENT SHEET 4-2-4A

10. Cartridge or pistol belts must not be used as weight belts. Why?

11. What are the three types of knives available to divers?

a.

b.

c.

12. Why is it not advisable to have a knife with a cork handle?

13. The diver must not secure the knife to his _____ _____.

14. Name the two basic types of swim fins.

a.

b.

15. Which type swimfin would tend to cause leg cramps sooner? Why?

16. Diver's watches must be:

a.

b.

c.

17. The watch should be worn:

18. The depth guage measures the _____ created by the _____ _____ above the diver and is calibrated to provide a direct reading of depth in _____.

19. A depth guage must be checked for accuracy:

a.

b.

20. The selection of the type of wet suit is determined by:

21. Explain the principle of the wet suit in providing warmth for the diver.

22. What is the advantage of a non-compressible wet suit over others?

23. What are the advantages of using a urı suit?

24. Each signal of the Mark 13, Mod 0 Flare lasts for approximately _____. _____.

25. The night end of the Mark 13, Mod 0 Flare is identifiable by:

26. Name three types of lifelines used in SCUBA and describe each.

a.

b.

c.

27. What is the compass approved for use by Navy Divers?

28. What types of wrist bands are not acceptable for wrist devices worn in SCUBA?

a.

b.

29. Name four kinds of hazardous equipment that should not be used in diving SCUBA, and explain why.

a.

b.

c.

d.

378 ASSIGNMENT SHEET 4-2-6A

SCUBA AND UNDERWATER ACCESSORIES

ON THE DRAWINGS ABOVE, LOCATE AND LABEL THE FOLLOWING EQUIPMENT:

FACE MASK, SWIM FINS, KNIFE, LIFE VEST, SCUBA CYLINDER, BREATHING HOSE, MOUTHPIECE, WEIGHT BELT, WET SUIT, DEPTH GAGE, WRIST WATCH.

BOTH DIVERS ABOVE, ACCORDING TO THE U.S. NAVY DIVING MANUAL, HAVE TWO (2) ITEMS OF EQUIPMENT WORN IMPROPERLY OR NOT AT ALL. WHAT ARE THEY?

ASSIGNMENT SHEET 4-2-7A

TITLE: Open Circuit SCUBA Cylinder and Manifold Assembly

STUDY ASSIGNMENT

U.S.Navy Diving Manual, Volume I, page 5-5 through 5-7

Student Guide Information Sheet, 4-2, NAVSHIPS 0994-008-0100, Chapter 1, Chapter 2, para. 2-2, 2-4, 2-5, 2-6, 2-10, 2-11, 2-13, Chapter 3, para 3-2, 3-3, 3-4, 3-5, 3-6, 3-7, 3-8, 3-9, 3-10, Chapter 4, Chapter 5, Chapter 6, Section III, para. 2-5, 2-6, 2-7, 2-8, 2-9, 2-10, 2-15, 2-16, 2-18, 2-21, 2-22, 2-23, 2-24, 2-25

STUDY QUESTIONS

1. What two types of cylinders are approved for U.S.Navy use? What are the pressure ratings for each?

2. Non-magnetic (aluminum) cylinders, manufactured under special Navy contract for use by Explosive Ordnance Disposal Teams, will not bear _____ markings.

3. What is the frequency of hydrostatic testing for aluminum cylinders?

4. The volume of a cylinder is:

5. The capacity of a cylinder is:

6. What function does the manifold perform?

7. What purposes are served by the air reserve mechanism?

   a.

   b.

8. A dive must be terminated when:

9. All straps used on cylinder harness must have:

10. What are the two controls on the air cylinder assembly?

11. The normal position of the reserve air supply pull rod is:

12. The reserve air provides _____ to _____ minutes of breathing air.

13. The manifold consists of:

    a.

    b.

    c.

14. The air reserve valve is a _____ _____ valve with a _____ override.

ASSIGNMENT SHEET 4-2-9A

TITLE: Double Hose Regulator

STUDY ASSIGNMENT

U.S.Navy Diving Manual, Volume I, pages 5-3, through 5-5

Student Guide Information Sheet 4-2, NAVSHIPS 394-0065

STUDY QUESTIONS

1. Why would a diver using a double hose regulator find that his facial muscles start to fatigue during a dive?

2. What is the major advantage of the double hose system?

ASSIGNMENT SHEET 4-2-10A

TITLE: Single Hose Regulator

STUDY ASSIGNMENT

U.S. Navy Diving Manual Volume 1 page 5-2 and 5-3

Student Guide Information Sheet 4-2 NAVSHIPS 0994-008-0100 All sections concerning regulators.

STUDY QUESTIONS

1. List some advantages of the single hose regulator

a
b.
c.
d

2. What is the principle disadvantage of the single hose regulator?

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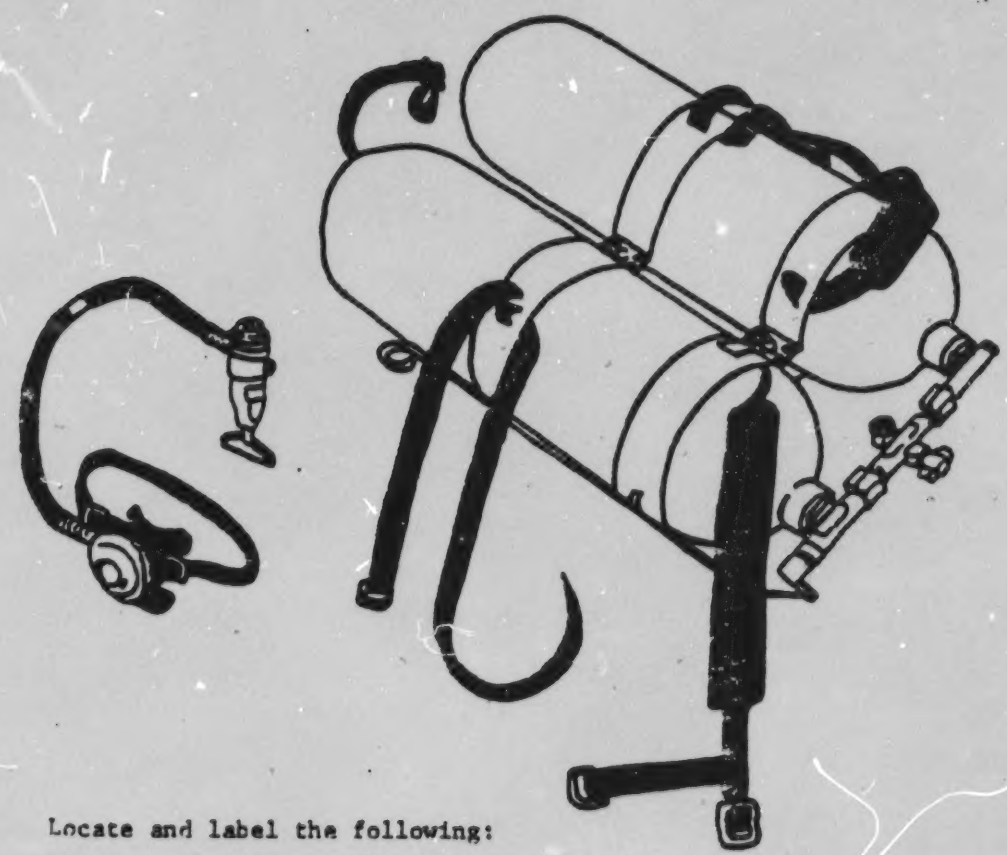
ASSIGNMENT SHEET 4-2-11A

SELF CONTAINED UNDERWATER BREATHING APPARATUS



Locate and label the following:

1. Purge Button
2. Intermediate Pressure Hose
3. Air Cylinders
4. Cylinder Block Manifold Assembly
5. Regulator Strap
6. Protection Cap Assembly
7. Reserve Air Supply Pull Rod
8. Connection Tee
9. Harness Assembly
10. 1st Stage Regulator
11. Yoke
12. Air Shutoff Valve
13. 2nd Stage Regulator
14. Mouthpiece

INFORMATION SHEET 4-3-II

TITLE: Open Circuit SCUBA Charging

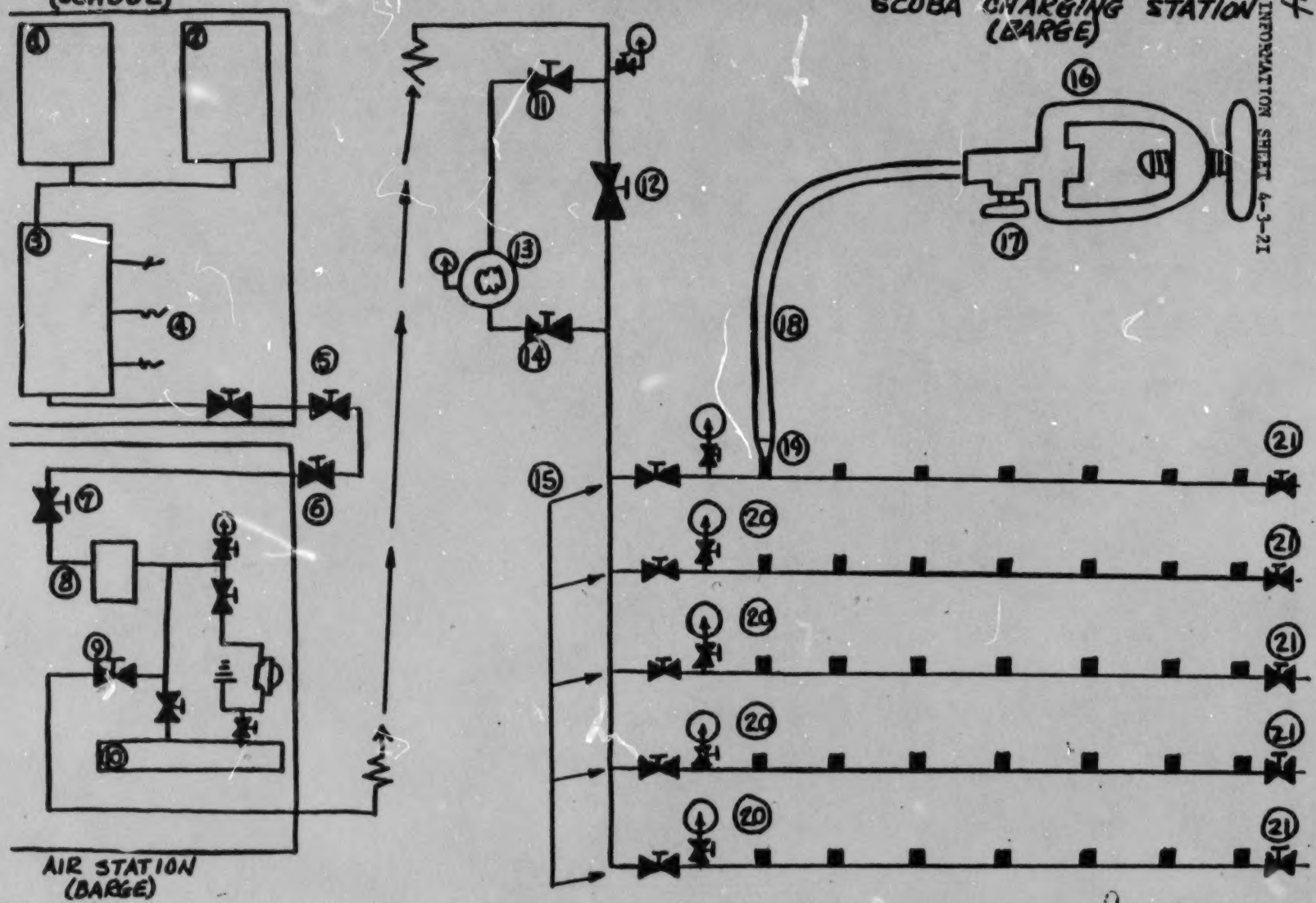
INTRODUCTION

Open circuit SCUBA cylinders must be refilled or "topped off" following every dive. The procedure for doing this is called "charging". In this lesson topic, you will be given the charging air system and charging checklist for use at this school. This information will probably not be applicable to your duty assignment diving locker. True, there will be similarities (a ship's air system will have many or all of the components of the school's system), but it's likely that it will not be arranged the same. What we want you to learn, then, is (1) how to charge open circuit SCUBA cylinders here at this school, (2) general rules regarding open circuit SCUBA cylinder charging, and (3) the major components of a typical diver's air system used to charge open circuit SCUBA.

REFERENCES

U.S.Navy Diving Manual, Volume I

NAVAL SCHOOL DIVING AND SALVAGE
SCUBA CHARGING SYSTEM



INFORMATION SHEET 4-3-3I

NAVAL SCHOOL DIVING AND SALVAGE SCUBA CHARGING AIR SYSTEM

AIR SOURCE (SCHOOL)

1 - High Pressure Compressor
2 - High Pressure Compressor
3 - High Pressure Air Manifold
4 - To High Pressure Air Flasks
5 - High Pressure Cut-off (Pierside)

AIR STATION (BARGE)

6 - High Pressure Cut-off
7 - High Pressure Cut-off
8 - Micron Filter
9 - High Pressure Cut-off SCUBA Room
10- Low Pressure System

SCUBA CHARGING STATION (SCUBA LOCKER)

11-High Pressure Cut-off (to H.P. Reducer)
12-High Pressure Cut-off (to charging station)
13-High Pressure Reducer - Hand Loaded
14-High Pressure Cut-off (to H.P. Reducer)
15-High Pressure Charging Valves
16-SCUBA Charging Yoke
17-Bleed Valve
18-High Pressure Hose
19-High Pressure Quick Disconnect
20-High Pressure Charging Gauge
21-Bleed Valve

386 INFORMATION SHEET 4-3-4I

NSDS OPEN CIRCUIT SCUBA CHARGING CHECKLIST

1. Two men are required for a charging detail.

2. Insure there is sufficient pressure in the High Pressure Banks - minimum of 2000psi reading on the master gauge.

3. Determine what type of cylinders will be charged (2250 psi or 3000 psi). NEVER MIX BOTH TYPES OF CYLINDERS IN THE SAME CHARGING LINE.

4. Insure all charging hoses are securely locked in the High Pressure Fittings, and that the hoses are attached to the cylinders to be filled. All secondary relief valves closed.

5. All reserve valves on the cylinder manifolds in the DOWN position.

6. Main relief valve on the Cylinder Rack closed.

7. Open all on/off manifold valves.

8. Position one man at the main charging valve, the other at the main relief valve.

9. Insure that all other personnel are kept away from the immediate vicinity of the charging hoses and fittings.

10. Slowly open the main charging valve and begin charging. DO NOT EXCEED 400 psi per minute.

11. Upon reaching the maximum rated psi for the cylinders, main charging valve is secured.

12. All on/off manifold valves are closed. Reserve handles are placed in the UP position.

13. Relief Valve Man will sound off with "BLEEDING DOWN" and open the relief valve slowly, insuring that his body is away from the outlet side of the valve.

14. All charging hoses are disconnected from the SCUBA cylinders and masking tape is placed over the inlet orifice on the manifolds.

15. Charging procedures are secured.

ASSIGNMENT SHEET 4-3-1A

TITLE: Open Circuit SCUBA Charging

LESSON TOPIC OBJECTIVE

Terminal Objective
1. When the student completes this course he will be able to demonstrate the open circuit SCUBA charging procedures without error.

Enabling Objectives
1. Orally describe a typical diver's breathing air system by tracing it from the compressor/flask through the charging lines to the open circuit SCUBA cylinders.

2. Given a standard print of a typical diver's breathing air system, label the physical location of the major components using the proper nomenclature.

3. Orally describe the interrelation of Charles' Law with charging open circuit SCUBA.

4. Given an open circuit SCUBA charging checklist (for the available system) prepare, activate and secure (after charging) the air supply delivery system.

STUDY ASSIGNMENT

U.S.Navy Diving Manual, Volume I, Table 5-2, para. 5.2.1, 5.2.1.1, 5.2.1.2, 5.2.1.3, and 5.2.1.4

STUDY QUESTIONS

1. When filling SCUBA cylinders, never use:

   a. compressed air
   b. oxygen
   c. hydrogen
   d. none of the above

2. Never leave filled tanks in direct _____.

3. Always use reliable, _____ _____ _____ to measure tank pressure.

4. Steel cylinders must be inspected every _____ _____ and aluminum cylinders every _____ years.

5. The duration of air supply of any cylinder or combination of cylinders is dependent upon:

   a. b. c.

ASSIGNMENT SHEET 4-3-2A

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6. According to Table 5-3, U.S.Navy Diving Manual, Volume I, what is the air supply duration of a set of twin Aluminum 90 - SCF SCUBA cylinders used by a diver swimming at 0.85 knot at a depth of 60 feet?

7. Determine the duration of air supply to a diver doing light work at 90 feet using twin "90" cubic foot cylinders charged to 2500 psig.

8. No matter what the source of air or method used in charging SCUBA cylinders, the air used must meet purity standards established by the

_____ _____ _____ _____ _____ _____ _____.

9. Air supplied through a high pressure air compressor should be analyzed _____.

10. In the absence of appropriate naval sources, air for SCUBA diving operations may be procured from _____ _____.

11. Cylinders used in SCUBA operations must contain the following markings:

a.

b.

c.

d.

12. _____ is the fastest and most effective method for charging open circuit SCUBA.

13. When charging SCUBA cylinders using the cascading system, the air flow must be controlled so that the rate of pressure increase (in the SCUBA cylinder) does not exceed _____ psig per _____. This control will prevent _____.

14. Engine-driven compressors used for charging SCUBA cylinder must be mounted so that there is no danger of:

JOB SHEET 4-3-1J

TITLE: Open Circuit SCUBA Charging

INTRODUCTION

The important thing to remember when completing this practical evolution and, in fact, the entire lesson topic, are, first, charging open circuit SCUBA is dangerous and safety precautions must be observed at all times and, second, the system in use is for this school only. Your ship board charging system may be different although there will be similarities in equipment components.

REFERENCES

U.S. Navy Diving Manual, Volume I

EQUIPMENT AND MATERIAL

Open Circuit SCUBA Cylinders requiring charging and open circuit SCUBA charging system.

JOB STEPS

1.Complete all items on the School's Charging Checklist.

SELF TEST ITEMS

1. What is the maximum charging rate? Are you exceeding it?

INFORMATION SHEET 4-4-1I

TITLE: Planning

INTRODUCTION

The success of any diving operation is directly related to the planning that went into it. The information contained in this lesson topic will provide you with the basic data and references necessary to plan your dives before a diver enters the water. Later, you will be required to use this information in planning a practical evolution for your class.

REFERENCES

U.S.Naving Diving Manual, Volume I

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ASSIGNMENT SHEET 4-4-1A

TITLE: Planning

LESSON TOPIC OBJECTIVES

Terminal Objective

1. When the student completes this course he will be able to, given a typical fleet SCUBA diving task, illustrate proper planning procedures by outlining steps necessary for a successful completion of the task.

Enabling Objectives

1. Orally describe the application and/or use of open circuit SCUBA diving.

2. Orally discuss, with class members, procedures necessary for proper planning of the 130 feet dive for qualification.

3. Use the pre-dive checklist contained in the U.S.Navy Diving Manual, Volume I, for planning the 130 feet qualification dive.

STUDY ASSIGNMENT

U.S.Navy Diving Manual, Volume I, Chapter 4 and Appendix F

STUDY QUESTIONS

1. What are the two main facets of the statement defining the objective of a diving mission?

2. The extent and type of information gathered for planning a dive is dependent upon three factors. What are they?

3. For operations involving a search for an object underwater, how can advance data help?

4. Most of the data gathered for planning will come from:

5. What is the most critical weather factor?

6. Extremes of temperature are more of a problem for the diver or topside personnel?

7. What is the Equivalent Chill Temperature, if the temperature is 0° and there are 15 mph winds?

ASSIGNMENT SHEET 4-4-2A

8. Draw the Signal Flags necessary to convey the message, "A diver will be sent as soon as possible."

9. What is the prime consideration in determining whether surface visibility is adequate or not?

10. Depth must be carefully measured by _____ _____ _____ to insure accuracy.

11. What is the probable visibility and diver mobility of water with a sand bottom?

12. What apparatus is used to protect the diver against the hazards of unusually warm water?

13. For any diving operation, the planning effort must identify resources known to be available, which include:

14. What one action, when properly completed, will insure that any member of the diving team could take prompt action in the event of an emergency?

15. What are two common failures in planning diving operations?

1.

2.

16. Good planning must carry the diving team through the objective, _____ and the proper filing of all _____ and _____.

17. What is the maximum bottom time allowable, which would not require decompression for a dive of 90 feet?

18. Except in an emergency, SCUBA diving operations should <u>never</u> require _____.

19. What are the disadvantages of Deep Sea Diving not present in SCUBA diving?

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ASSIGNMENT SHEET 4-4-3A

20. What are two prime factors determining choice of technique for a particular diving operation?

21. What specific limitation is placed on dives in excess of 170 feet?

22. No matter how logical they may seem at the time, unauthorized _____ to diving equipment are not permitted.

23. Of the following equipment, circle that which is required to be aboard a diving boat:

Boat Hook Matches Flares Heaving Line Grease

Tank Rack, SCUBA Pencils Tide Tables

24. The ultimate responsibility for the safe and effective conduct of all diving operations rests with:

a. the divers
b. the Master Diver on board
c. the Commanding Officer
d. the Topside Diving Officer

25. The Diving Officer has to be a qualified diver.

True False

26. Who is responsible for gathering appropriate data for analyzing the results of the diving mission, and for preparing reports for submission to higher authority?

27. Name the members (by position) of the diving crew.

28. Insofar as possible, each member of the team should be qualified to act in any _____ on the _____.

JOB SHEET 4-3-1J

TITLE: Surface Swim

INTRODUCTION

This particular practical evolution is an extension of the work you have done in the swimming pool during the first week of SCUBA training. It is also a BUPERS Qualification Factor that a SCUBA diver be able to swim 1000 yards on the surface using mask, fins and life vest.

For review, it may be wise to read paragraph 5.3.1, U.S.Navy Diving Manual, Volume I, which offers basic simple surface swimming techniques.

REFERENCE

U.S.Navy Diving Manual, Volume I

EQUIPMENT AND MATERIAL

Bathing Suit, SCUBA Face Mask, Swim Fins, Life Vest, Snorkel, Knife and Flare. Wet Suit Tops may be worn if water temperature is below 78° or water is polluted.

JOB STEPS

1. Enter the water using the front step method.

2. Tread water until all students have entered the water and formed a line.

3. Begin swimming toward the objective (indicated by the instructor) at "GO".

4. Complete the total 1000 yards within 20 minutes.

SELF TEST ITEMS

1. Are you using a strong, steady kick from the hips? This achieves maximum benefits from the swim fins.

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INFORMATION SHEET 4-6-1I

TITLE: Underwater Compass Swim

INTRODUCTION

Knowing how to use a compass underwater is a skill necessary for a diver using SCUBA. Whether involved in clandestine operations, night operations or open sea work where taking bearings on fixed objects on the surface is difficult or impossible, the use of a compass may be the only means available to the diver for navigation to and from his objective. The information contained in this lesson topic is designed to acquaint you with the compass and its use. Following the classroom portion, you and your buddy will complete at least one 500 yard compass swim for practical experience.

REFERENCE

U.S.Navy Diving Manual, Volume I
Instructions for LS-1 Compass
UDT Handbook
NAVSHIPS INST 9940.16A

INFORMATION SHEET 4-6-2I

HOW TO USE THE LS-1 COMPASS

To get a particular bearing, aim the bold lubber's line at the target (or desired direction) and rotate the bezel until the arrow point is aligned with the "North" arrow on the floating compass card. You will note by looking into the side window of the compass that this action also aligns the side numbers of the bezel with corresponding side numbers on the compass card. With this accurate Dual Diget reference, it is only necessary to keep the corresponding numbers aligned to follow a predetermined course. Any course deviation by the diver will be immediately apparent as the aligned reference numbers move out of the exact register.

For less critical top-reading reference it is only necessary to swim the desired course while keeping the "North" arrow point of the compass card aligned with the corresponding preset luminous arrow point of the bezel.

DRIFT CALCULATION: There is no set formula for drift compensation because of the incalculable variations of current speed and swimming speed of the diver. Even these two factors cannot be assumed to remain constant on the return or on subsequent swims. Drift compensation is therefore left to the experience and common sense of the diver as applied to his individual needs.

RETURN BEARING: The following section explains swimming a reciprocal or direct-return course. However, if the diver strays any considerable distance after reaching his destination, he should take a new bearing on his water-entry point and proceed directly on the new return course.

HOW TO SWIM A RECIPROCAL COURSE WITH THE LS-1

It is often necessary for the diver to swim a considerable distance to reach his objective. Because of possible unavoidable limitations due to diminishing air supply and cold-water exposure, it may be imperative that the diver return to his water-entry point by the most direct route. The direct return course is exactly 180° opposite the original course and is referred to as the "Reciprocal Course".

The LS-1 eliminates the need for numerical calculations in establishing the reciprocal course. The Dual Digit reading of the reciprocal course can be brought into register by rotating the bezel 180°. If the bezel is rotated 180° while on the original course, the luminous bezel arrow point will align with the compass "S". As the diver assumes the reciprocal course, the North arrow will move under the arrow of the bezel and the two arrow points will realign. This will automatically align the reciprocal Dual Digit Readout numbers in the viewing window.

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INFORMATION SHEET 4-6-3I

For a more precise realignment of the compass bezel in setting the reciprocal course, use the luminous lubber's line and the peripheral bezel degree numbers. For example: if the original course is 30 (300°), the lubber's line will be pointed toward the 30 and on the window side it will be pointing at 12 (120°). Using this 180° reference, turn the bezel until the positions of the two numbers are exactly reversed, with the lubber's line pointing toward the 12 (away from the diver) and pointing at the 30 on the window side (toward the diver).

For a more casual top-reading reference in assuming a reciprocal course (without moving the bezel), simply change direction until the compass "S" is aligned with the bezel arrow point.

Sometimes under the pressure of depth and circumstances, a certain amount of confustion is unavoidable. Remember that the numerical compass bearing of the original course is the constant and unchanging factor (discounting drift and course deviation). Keeping this in mind, it is always possible to reestablish the desired compass bearing even though the bezel has been rotated off the original or intended course.

Where light and bottom conditions permit, it is possible to establish a visual reference which may be advantageous in initial compass orientation dives. This is done simply by dragging a discernable furrow in the bottom before terminating the original compass course. This in-line furrow gives the diver a "third-party" reference while familiarizing himself with the simple mechanics of the compass.

ASSIGNMENT SHEET 4-6-1A

TITLE: Underwater Compass Swim

LESSON TOPIC OBJECTIVES

Terminal Objective
1. When the student completes this course he will be able to, in open water, swim 500 yards, underwater, with open circuit SCUBA, as a member of a team, on a compass course, arriving at a designated point.

Enabling Objectives
1. Demonstrate the setting and use of an underwater compass.

2. Swim 500 yards underwater with open circuit SCUBA, as a member of a team, on a compass course, arriving at a designated area.

STUDY ASSIGNMENT

Student Guide Information Sheet 4-6-2I and 4-6-3I, Underwater Compass Swim.

U.S.Navy Diving Manual, Volume I, para. 5.1.2.6

STUDY QUESTIONS

1. What is the formula for drift calculation?

2. What is meant by the term "reciprocal course"?

3. During a reciprocal course swim, what is the constant factor?

4. During compass familarization dives, what is one suggested method of securing a "third-party" reference?

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JOB SHEET 4-6-LJ

TITLE: Underwater Compass Swim

INTRODUCTION

Completion of this practical evolution brings you one step closer to becoming a certified Navy SCUBA Diver, for not only are compass swims important for their experience value, but a Bureau of Personnel Qualification Factor for SCUBA Divers is to be able to swim 500 yards on a compass course.

Important things to remember during your swim are to keep everything in line; the lubber's line and your body, the lubber's line and the objective and the bezel mark and magnetic north. Perhaps a review of your Notetaking Outline would be wise at this time.

REFERENCES

U.S.Navy Diving Manual, Volume I
Instructions for LS-1 Compass

EQUIPMENT AND MATERIAL

Bathing Suit, Open Circuit SCUBA Face Mask, Swim Fins, Life Vest, Knife, Flare, SCUBA Cylinders, Regulator, Watch, Depth Guage, and Compass. Wet Suits may be worn if the water temperature is below 78° or the water is polluted.

JOB STEPS

1. Dress in open circuit SCUBA equipment.

2. Secure a buoy to the diver of the team without the compass.

3. Receive objective from the instructor.

4. Enter the water.

5. Take initial bearing on the objective before leaving the surface. Align compass.

6. Leave surface and commence swimming toward objective.

   a. Keep lubber's line and body aligned

   b. Keep bezel mark and magnet north aligned.

   c. Keep compass level

JOB SHEET 4-6-2J

7. Upon arrival at objective, surface and await workboat. If workboat is not close by, orally inflate the life vest and remain close to the objective until picked up.

SELF TEST ITEMS

1. Do you keep your body, the lubber's line and bezel marks in proper alignment during the swim?

2. Are you having to make large corrections at your compass reading stops?

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ASSIGNMENT SHEET 4-7-1A

TITLE: Clearing, Ditching, and Donning Open Circuit SCUBA

Phase I

LESSON TOPIC OBJECTIVES

Terminal Objectives

1. When the student completes this course, he will be able to demonstrate procedures for clearing open circuit SCUBA without error.

2. When the student completes this course he will be able to demonstrate proper procedures for ditching and donning open circuit SCUBA, in accordance with the U.S. Navy Diving Manual.

3. When the student completes this course, he will be able to, in open water, swim to a depth of 130 feet using open circuit SCUBA.

Enabling Objectives

1. In a swimming pool, first at a depth of four feet and then at a depth of at least nine feet, using open circuit SCUBA, demonstrate:

   a. the ability to breathe underwater.
   b. the top pressure face mask clearing procedure.
   c. the side pressure face mask clearing procedure.
   d. single/double house clearing procedures.
   e. buddy breathing

2. At a swimming pool, first at a depth of four feet and then at a depth of at least nine feet, using open circuit SCUBA, demonstrate ditching and donning procedures in accordance with the U.S. Navy Diving Manual, Volume I.

3. In a swimming pool, first at a depth of four feet and then at a depth of at least nine feet, using open circuit SCUBA, demonstrate ditching and donning procedures in accordance with the U.S. Navy Diving Manual, Volume I.

3. In a swimming pool, at a depth of at least nine feet, using open circuit SCUBA, demonstrate the front step method of water entry.

4. In a swimming pool, at a depth of at least nine feet, using open circuit SCUBA, demonstrate the ability to remain submerged under adverse conditions by properly responding to instructor imposed emergency situations (i.e., elimination of air supply, removal of equipment, etc.) in accordance with Diving Training Standards.

5. In open water, at a depth of at least ten feet, using open circuit SCUBA, demonstrate:

   a. the ability to breath underwater.
   b. the top pressure face mask clearing procedure.
   c. the side pressure face mask clearing procedure.
   d. regulator clearing procedures.

6. In open water, at a depth of at least ten feet, using open circuit SCUBA, demonstrate the front step method of water entry.

7. In open water, at a depth of at least twenty feet, using open circuit SCUBA and proper tools, complete the Single Flange project in accordance with Diving Training Standards.

8. In open water, at a depth of at least twenty feet, as a member of a two-man team, using open circuit SCUBA and proper tools, complete the Two-Man Flange project in accordance with Diving Training Standards.

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ASSIGNMENT SHEET 4-7-3A

TITLE: Clearing, Ditching and Donning Open Circuit SCUBA

PHASE I - Swimming Pool

STUDY ASSIGNMENT

U.S.Navy Diving Manual, Volume I, para. 5.1.2.5, 5.2.3.2, 5.3.1, and 5.3.3.2

STUDY QUESTIONS

1. Whenever possible, when using open circuit SCUBA, entry into the water should be made by _____.

2. Several basic rules apply to all methods of entering the water. Complete the following:

a. LOOK

b. TUCK

c. HOLD

3. The most frequently used method of entering the water using open circuit SCUBA is the _____ _____ or _____ _____.

4. The rear jump or step-in water entry method is used when:

5. The rear roll is normally used when entering the water from:

6. If a diver is entering a high to moderate surf from the beach, what entry method should be used?

7. Why should the dive boat be moored as close to the dive site as possible?

8. What is the single most important factor in surface swimming with SCUBA?

9. What stroke should be used for short swims on the surface when diving SCUBA?

JOB SHEET 4-7-1J

TITLE: Clearing Snorkel

INTRODUCTION

This practical evolution and subsequent swimming pool evolutions are designed to acquaint you with the snorkel. The snorkel allows the diver to swim on the surface while keeping his face in the water, thus enabling him to search shallow depths and conserve the SCUBA air supply.

REFERENCES

U.S.Navy Diving Manual, Volume I

EQUIPMENT AND MATERIAL

Open Circuit SCUBA Face Mask, Swim Fins, Life Vest, Snorkel, and Bathing Suit. Wet Suit tops may be worn if water temperature is below 78°.

JOB STEPS

1. In shallow (4') end of the pool, take a breath and submerge until the snorkel fills with water.

2. Surface and exhale through snorkel blowing water out.

3. Continue to breathe through the snorkel.

4. Repeat procedure.

SELF TEST ITEMS

1. Perform the snorkel clearing exercise three (3) times without taking your face from the water.

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JOB SHEET 4-7-2J

TITLE: Clearing the Face Mask

INTRODUCTION

The mastery of clearing one's face mask is an important skill to develop and one that is basic to using SCUBA. Some water seepage into the mask is a normal situation and is often useful in defogging the lens. However, too much water can be harmful, or, at least, uncomfortable, so clearing procedures are necessary. This particular practical evolution is concerned with the front and side pressure methods of clearing and doesn not train in clearing masks with purge valves.

REFERENCES

U.S.Navy Diving Manual, Volume 1

EQUIPMENT AND MATERIALS

Open Circuit SCUBA Face Mask, Swim Fins, Life Vest, Snorkel, and Bathing Suit. Wet suit tops may be worn if the water temperature is below 78°.

JOB STEPS

Front Pressure Method of Clearing the Face Mask

1. In the shallow (4') end of the swimming pool, with head submerged, break the seal and allow water to enter the face mask.

2. Leaning the head back, apply pressure to top front of face mask, while exhaling through the nose.

3. Continue procedure until mask is free of water.

Side Pressure Method of Clearing the Face Mask

1. In shallow (4') end of the swimming pool, with head submerged, break the seal and allow water to enter the face mask.

2. Leaning head to one side, apply pressure to the side of the face mask nearest the surface, while exhaling through the nose.

3. Continue the procedure until the mask is free of water.

SELF TEST ITEMS

1. Perform the front and side pressure methods of face mask clearing at varying depths. Place mask on bottom of pool, recover, don, clear and return to the surface.

JOB SHEET 4-7-3J

TITLE: Surface Swimming with Snorkel

INTRODUCTION

Swimming with a snorkel is valuable to a SCUBA diver for two important reasons. First, a diver, in relatively clear water, can search shallow depths using a snorkel, thereby conserving the SCUBA air supply. Secondly, when surface swimming, using the snorkel allows the diver to keep his head down and is less tiring. The evolution of swimming with a snorkel but without facemask forces the diver to breathe through his mouth and is an excellent pre-training for using SCUBA.

REFERENCES

USS. Navy Diving Manual, Volume I

EQUIPMENT AND MATERIAL

Open circuit SCUBA Face Mask, Swim Fins, Life Vest, Snorkel and Bathing Suit. Wet suit tops may be used if the water temperature is below [illegible]°.

JOB STEPS

1. In the swimming pool, with face mask around the diver's neck, keep face down while surface swimming, around pool, using a snorkel. Swim using the legs only. Repeat as necessary.

2. In the swimming pool, using face mask and snorkel, keep face down while surface swimming around pool. Swim using legs only. Repeat as necessary.

SELF TEST ITEMS

1. Perform the surface swimming, using snorkel, evolutions without facemask until you feel comfortable. This is an excellent training aid for diving SCUBA using a regulator, as the diver is forced to breathe through his mouth.

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ASSIGNMENT SHEET 4-7-1A

TITLE: Clearing, Ditching and Donning Open Circuit SCUBA

Phase II - Swimming Pool

STUDY ASSIGNMENT

U.S.Navy Diving Manual, Volume I, para. 5.2.3.3, 5.3.2, 5.3.3, 5.3.3.1, 5.3.3.4, 5.3.3.10, and 5.3.4

STUDY QUESTIONS

1. In the water, and prior to descent, the diver makes final checks of his and his buddy's equipment. He must:

a. Make a _____ check of the SCUBA; _____ should be easy, without resistance and without evidence of _____ _____ into the system.

b. _____ check his buddy's system for _____, especially at _____ _____(regulator at _____ _____, hoses at _____ and at _____).

c. Check his buddy for loose or entangled _____

d. Check his _____ _____ seal.

e. Check buoyancy. A SCUBA Diver should strive for _____ buoyancy.

2. What is the danger of relying on the rotating bezel on the diving watch during a SCUBA dive?

3. What are two methods used to counter the danger above?

4. The rate of descent should never exceed _____ feet per minute. How should the rate of descent be governed?

5. If observed conditions call for any major change in the dive plan, the dive should be:

a. continued under the same plan
b. continued under an alternate plan
c. aborted
d. aborted until discussed with the Diving Supervisor

6. Divers must learn to breathe in an _____, _____ _____ and at a steady pace when using SCUBA. The rate of _____ should be paced to the _____ cycle.

7. What is meant by "skip-breathing". How does it pertain to SCUBA diving?

8. What are the dangers of skip-breathing and breath holding when diving SCUBA?

9. A marked increase in breathing resistance, when diving SCUBA, is the diver's signal to:

10. When working in an area with a muddy bottom, what three actions should be taken by the diver?

a.

b.

c.

11. Depth perception underwater is altered on a basis of 3 to 4. Explain what this means.

12. If practical, swim _____ the current to approach a job site.

13. For a normal ascent, the rate should be approximately _____ feet per minute.

14. Divers should NEVER hold their breath during ascent because of the danger of _____ _____.

15. What two actions should be taken by the diver to prevent his head striking an object during ascent?

a.

b.

JOB SHEET 4-7-LJ (Phase II) 408

TITLE: Breathing Underwater with SCUBA Equipment

INTRODUCTION

This will be your first time in the water using open circuit SCUBA. Of course, the first skill to master is breathing underwater using the regulator. Once this has been mastered, we will proceed through more difficult evolutions.

REFERENCES

U.S.Navy Diving Manual, Volume I

EQUIPMENT AND MATERIAL

Bathing Suit, Open Circuit SCUBA Face Mask, Swim Fins, Life Vest, Weight Belt, Double Hose Regulator, Double 90's or 72's Cylinders. Wet suit tops may be worn if the water temperature is below 78°.

JOB STEPS

1. Student dons open circuit SCUBA gear. Place face mask around neck and swim fins will be carried on one arm.

2. Enter the shallow (4') end of the swimming pool by backing down the ladder.

3. Stand by the edge of the pool forming a semi-circle.

4. Place mask on face.

5. Put regulator mouthpiece in mouth.

6. Take a breath to insure proper operation.

7. Submerge, sitting on the pool bottom with back to the side of the pool.

8. Continue to breathe at a slow steady rate until signalled by the instructor to surface.

SELF TEST ITEMS

1. Do you feel comfortable breathing with the regulator underwater?

JOB SHEETS 4-7-2J (Phase II)

409

TITLE: Single/Double Hose Regulator Clearing Procedures

INTRODUCTION

When diving SCUBA, there may be instances when the mouthpiece of the regulator is removed from the diver's mouth. It may be accidentally removed, as in the case of snagging the hose and pulling the regulator out, or removal may be necessary as in buddy breathing, a skill to be developed later. In any case, before the diver can continue breathing with the regulator, it is necessary to "clear" it or remove the water from the system. In using a double hose regulator, it is necessary to develop a physical skill. The single hose regulator with its purge button makes clearing a simple process. Both methods are important skills for the SCUBA Diver.

REFERENCES

U.S.Navy Diving Manual, Volume I

EQUIPMENT AND MATERIAL

Bathing Suit, Open Circuit SCUBA Face Mask, Swim Fins, Life Vest, Weight Belt, Double/Single Hose Regulator, Cylinders, Knife and Flare. Wet Suit tops may be worn if the water temperature is below 78°.

JOB STEPS (DOUBLE HOSE REGULATOR)

1. Student dons open circuit SCUBA equipment. Stand in shallow (4') end of the swimming pool with back to the side of the pool forming a semi-circle around the instructor.

2. Submerge, sitting on the pool bottom, breathing through the SCUBA regulator.

3. Take a breath.

4. Remove regulator mouthpiece from mouth, allowing it to flood.

5. Place regulator mouthpiece in mouth.

6. Roll to the left side.

7. Squeeze off the inhalation (right) hose of the regulator.

8. Blow through the regulator mouthpiece forcing the water out the exhaust (left) hose.

9. Release the inhalation hose.

10. Take a shallow breath. (Water may still be trapped in the mouthpiece).

410

JOB SHEET 4-7-3J (Phase II)

11. If there is water trapped in the mouthpiece, repeat the process. If not, resume normal breathing.

JOB STEPS (SINGLE HOSE REGULATOR)

1. Perform steps 1 through 4 above.

2. Press purge button on front of regulator.

3. Insert mouthpiece in mouth. (Steps 2 and 3 should be one motion)

4. Resume normal breathing.

SELF TEST ITEMS

1. Both single and double hose regulator clearing procedures should feel comfortable.

2. Are you panicky until you get through the procedure and resume normal breathing?

JOB SHEET 4-7-4J (Phase II)

411

TITLE: Water Entry

INTRODUCTION

This is the final lesson in water entry and will be accomplished with open circuit SCUBA equipment in place. Again, throughout training, unless otherwise directed, you will use the front-step method of entering the water in SCUBA gear.

REFERENCES

U.S.Navy Diving Manual, Volume I

EQUIPMENT AND MATERIAL

Bathing Suit, Open Circuit SCUBA Face Mask, Life Vest, Swim Fins, Weight Belt, Double Hose Regulator, Cylinders, Knife and Flare. Wet Suit tops may be worn if the water temperature is below 78°.

JOB STEPS

1. Student stands at the side of the pool (deepest end) dressed in open circuit SCUBA equipment.

2. Place one hand over the face mask and regulator, holding them in place against the face.

3. Place the other hand on the waist strap of the SCUBA cylinder harness. Push downward with slight pressure.

4. Lean slightly forward.

5. Take a large step forward into the water.

6. Check out your buddy upon surfacing.

7. Signal the diving supervisor "O.K."

SELF TEST ITEMS

1. Face mask and regulator should not be dislodged. Cylinders should not strike the back of the diver's head.

4/2 JOB SHEET 4-7-5J (Phase II)

TITLE: Swimming with Open Circuit SCUBA

INTRODUCTION

Having developed skills in clearing open circuit SCUBA equipment, water entry and, most important, breathing underwater, it's now time to put them together and swim underwater using open circuit SCUBA.

REFERENCES

U.S.Navy Diving Manual, Volume I

EQUIPMENT AND MATERIAL

Bathing Suit, Open Circuit SCUBA Face Mask, Swim Fins, Life Vest, Weight Belt, Double Hose Regulator, Cylinders, Knife, and Flare. Wet Suit tops may be worn if water temperature is below 78°.

JOB STEPS

1. With your buddy, use the front-step entry method to enter the deep end of the swimming pool.

2. Surface.

3. Check out your buddy from proper implacement of equipment.

4. Signal supervisor "O.K."

5. Descend to bottom of the pool and begin swimming. (Legs straight, arms at sides) Swim around the pool staying near the sides.

6. Continue until signaled by the instructor to surface, or one of the diving pair goes on his reserve air supply.

SELF TEST ITEMS

1. Are you breathing at a slow, steady pace?

2. Can you clear your equipment without disrupting your swimming progress?

3. Are you comfortable?

ASSIGNMENT SHEET 4-7-1A

413

TITLE: Clearing, Ditching and Donning Open Circuit SCUBA

Phase III - Swimming Pool

STUDY ASSIGNMENT

U.S.Navy Diving Manual, Volume I, para. 5.3.3.7 and 5.3.5; Figure 5-43

STUDY QUESTIONS

1. Buddy Breathing is strictly and_____ _____.

2. When buddy breathing, each diver should take _____ breaths and hand the mouthpiece back to the buddy.

3. During buddy breathing, how could divers drift away from each other?

4. If using a double hose regulator in buddy breathing, the mouthpiece should be kept slightly higher than the regulator. Why?

5. When a situation requiring buddy breathing occurs, no attempt should be made to surface until:

6. During ascent, what must the diver without the mouthpiece do? Why?

7. What are the first and second actions of a SCUBA diver in a situation requiring an emergency ascent?

a.

b.

8. Why should a diver not ditch his regulator and cylinders unless absolutely nedessary?

9. In an emergency ascent situation, when a diver is unconscious, what actions should his buddy take? What should he never do?

10. In an emergency ascent, what must the diver do from leaving the bottom until he reaches the surface? Why?

JOB SHEET 4-7-1J (Phase III)

414

TITLE: Buddy Breathing

INTRODUCTION

One of the prime reasons for stressing and using the buddy system in SCUBA diving is so that the divers can help each other in the event of equipment malfunction or other emergency. Buddy breathing is an important function of the buddy system and, therefore, a skill to be developed. To emphasize-Buddy breathing is important. You may never need it, but if you do, you'll appreciate your experience during this practical evolution.

REFERENCES

U.S.Navy Diving Manual, Volume I

EQUIPMENT AND MATERIAL

Bathing Suit, Open Circuit SCUBA Face Mask, Swim Fins, Life Vest, Weight Belt, Double Hose Regulator, Cylinders, Knife and Flare. Wet Suit tops may be worn if the water temperature is below 78°.

JOB STEPS

There are three (3) positions for buddy breathing; front-to-front, side-by-side and piggy back. Essentially, they are the same procedure, the difference being the position of the divers in relation to each other.

The following procedures will be accomplished in the following sequence:

a. In the shallow (4') end of the swimming pool, standing, so that both divers heads are out of the water.

b. In the shallow (4') end of the swimming pool, sitting or kneeling, so that both divers are submerged.

c. In the deep (9+') end of the swimming pool or swimming around the pool with both divers submerged.

1. One diver remove his mouthpiece. Using double hose regulator, slip one arm through the hose to keep it out of the way.

2. The diver places his hand on the hand which the buddy is using to hold his mouthpiece. Divers maintain contact by grasping a strap or free arm with their other hand.

3. The buddy takes the mouthpiece from his mouth (after taking a breath) and passes it to the other diver.

4. The diver will guide it to his mouth. Both divers maintain direct contact with the mouthpiece.

JOB SHEET 4-7-2J (Phase III)

5. The diver takes two full breaths.

6. Hand the mouthpiece back to the buddy.

7. The buddy takes two breaths and begins the cycle again.

8. Repeat these procedures for front-to-front, side-by-side (single hose only) and piggy back positions.

SELF TEST ITEMS

1. Are you panicky waiting for your buddy to get the mouthpiece back to you?

2. Can you and your buddy establish a smooth rhythm?

3. Are you comfortable during this evolution?

JOB SHEET 4-7-3J (Phase III) 416

TITLE: Ditch and Don Open Circuit SCUBA Equipment and Emergency Ascent Training

INTRODUCTION

If a diver suddenly finds himself without air, or if his SCUBA becomes so entangled that he cannot free it, it will be necessary for him to make an emergency ascent, consisting of ditching his equipment and swimming to the surface. In a real situation, it would not be wise to ditch all SCUBA equipment (i.e. cylinders, fins) unless absolutely necessary. For this evolution, however, you will ditch all equipment, except the life vest, ascend under emergency conditions, and then return to the equipment, don it, clear it and swim off. Again, this is a natural progression of previously learned skills.

REFERENCES

U.S.Navy Diving Manual, Volume I

EQUIPMENT AND MATERIAL

Bathing Suit, Open Circuit SCUBA Face Mask, Swim Fins, Life Vest, Weight Belt, Double Hose Regulator, Cylinders, Knife and Flare. Wet Suit tops may be worn if the water temperature is below 78°.

JOB STEPS

1. Dressed in open circuit SCUBA equipment, descend to the bottom of the pool.

2. Sit on the bottom.

3. Remove the weight belt and lay it across your lap.

4. Pull the quick release straps on the SCUBA harness.

5. Holding the manifold with one hand, the diver pulls the SCUBA cylinders up and over his head while guiding the tanks with the other hand.

6. Once over the diver's head, shift the grip to the center of the cylinders and lower them between your legs. Do not release the mouthpiece. Continue to breather

7. Remove the weight belt from your lap and place it across the SCUBA cylinders.

8. Shift to a face-down position with legs and body extended away from the cylinders.

9. While holding to cylinders with one hand, remove swim fins and place them

under the cylinders (to prevent them from floating away).

10. Remove the face mask, tucking it away beneath the cylinders.

11. Take a half-breath and remove the mouthpiece, placing it under the cylinders.

12. Secure the air at the manifold.

13. Clear of the SCUBA, the diver assumes an upright position and raises one arm above his head.

14. Begin exhaling and continue until you reach the surface.

15. Upon a signal from the Topside Supervisor (instructor), take a breath and swim to the equipment on the bottom.

16. To don the SCUBA equipment, reverse the ditching procedures, making sure the gear (regulator and face mask) is properly cleared before use.

SELF TEST ITEMS

1. Ditching and donning should be done as fast as possible. Are you progressing at a reasonably steady rate?

418

JOB SHEET 4-7-3J (Phase III)

TITLE: Open Circuit SCUBA Harrassment

INTRODUCTION

As has been stressed throughout your training, SCUBA diving is the most dangerous of all the types of diving used in the Navy. This is because of a lack of direct contact with topside and a lack of communications - in other words, the two divers (buddies) are "on their own" (thus the name, Self Contained Underwater Breathing Apparatus). It is necessary, therefore, that the instructors insure your proficiency prior to allowing you to enter the open water phase of SCUBA training. Although this is not a Terminal Objective and will not, therefore, appear on your grade card, it is a most important check. If the instructor does not feel you are sufficiently proficient or comfortable using SCUBA, you will not proceed into the second week.

During training, the instructors have been harrassing you as your skills increase. You can look upon this evolution as a "final exam" for the week's practical work.

REFERENCES

U.S.Navy Diving Manual, Volume I

EQUIPMENT AND MATERIAL

Bathing Suit, Open Circuit SCUBA Face Mask, Swim Fins, Life Vest, Weight Belt, Double Hose Regulator, Cylinders, Knife and Flare. Wet Suit tops may be worn if the water temperature is below 78°.

JOB STEPS

1. Teams will make a normal front-step method water entry - air valve secured at the stop valve, face mask on the bottom of the pool at the deepest end.

2. After entry, divers turn air on, clear regulator.

3. Recover, clear and don face mask.

4. Team members (buddies) check each other for equipment alignment and operation. Make adjustments as necessary.

5. After determining everything is "Go", both team members signal the instructor "O.K." and swim off.

6. Teams will circle the swimming pool in a counter-clockwise direction remaining submerged.

7. Team members will ignore any activity regarding other teams. At no time will team members engage in harrassment of other teams.

8. Team members will assist each other during the emergency situations which will be imposed by the instructors.

9. Teams will remain submerged and continue swimming until both team members are on reserve air supply. At this time, divers will surface, orally inflate their life vests and swim on the surface until the harrassment exercise is completed. STUDENT DIVERS ARE NOT ALLOWED TO REST ON THE SIDE OF THE SWIMMING POOL AT ANY TIME DURING HARRASSMENT.

REMEMBER, this is a culmination of your SCUBA training during this first week, and, as such, is testing you on your acquired knowledge and skills in the use of the open circuit SCUBA equipment and your understanding of emergency procedures.

420
JOB SHEET 4-7-LJ

TITLE: Single Flange and Two-Man Flange Projects

Phase IV - Open Water

INTRODUCTION

The completion of the Single Flange and Two-Man Flange Projects will provide you with experience in performing mechanical work, using open circuit SCUBA, in a stationary position. It also provides situations where, (1) you will be working alone, surface tended, and (2) you will be working with a partner on a project that requires a degree of teamwork to be completed successfully.

REFERENCES

U.S.Navy Diving Manual

EQUIPMENT AND MATERIAL

Bathing Suit, Open Circuit SCUBA Face Mask, Swim Fins, Life Vest, Weight Belt, Regulator, Cylinders, Knife, and Flare. Wet Suit tops may be worn if the water temperature is below 78°.

JOB STEPS (SINGLE FLANGE)

1. Diver dresses in open circuit SCUBA equipment. Secure a tending line around his waist.

2. Diver will use proper line-pull signals throughout this evolution.

3. Use front-step method of water entry.

4. Surface, check equipment, signal instructor, "O.K." and descend to bottom.

5. Diver removes nuts, bolts and gasket. (Put nuts and bolts in tool bag)

6. Use line-pull signals and send for square mark.

7. Secure gasket to squard mark and send it topside.

8. Recover gasket from topside.

9. Reassemble flange in reverse order making sure bench marks are aligned and gasket is in place.

10. Come to surface.

JOB SHEET 4-7-2J (Phase IV)

JOB STEPS (TWO-MAN FLANGE)

1. Two divers dress in open circuit SCUBA equipment. Secure a tending line around both diver's waists.

2. Both divers will use proper line-pull signals during this evolutions.

3. Use front-step method of water entry.

4. Surface, check equipment, signal instructor, "O.K." and descend to bottom.

5. Each diver disassembles a flange and removes the rubber gasket.

6. Diver #1 requests a square mark.

7. Diver #1 secures both gaskets to the square mark and sends it topside.

8. Recover gaskets.

9. Both divers replace their respective gaskets and secure them with nuts and bolts.

10. Come to surface.

INFORMATION SHEET 4-9-1I

TITLE: Night Bottom Search

INTRODUCTION

Because of the mobility and minimum bottom disturbance, SCUBA is ideally suited for searching operations. As such, it has become important to law enforcement units as well as the military. The information plus the practical evolutions contained in this lesson topic will provide you with the basics needed to become proficient at searching and searching techniques during daylight and dark, using open circuit SCUBA.

REFERENCES

U.S.Navy Diving Manual, Volume I
NAVSHIPS Inst. 9940.16A

SURFACE TENDED SEARCH

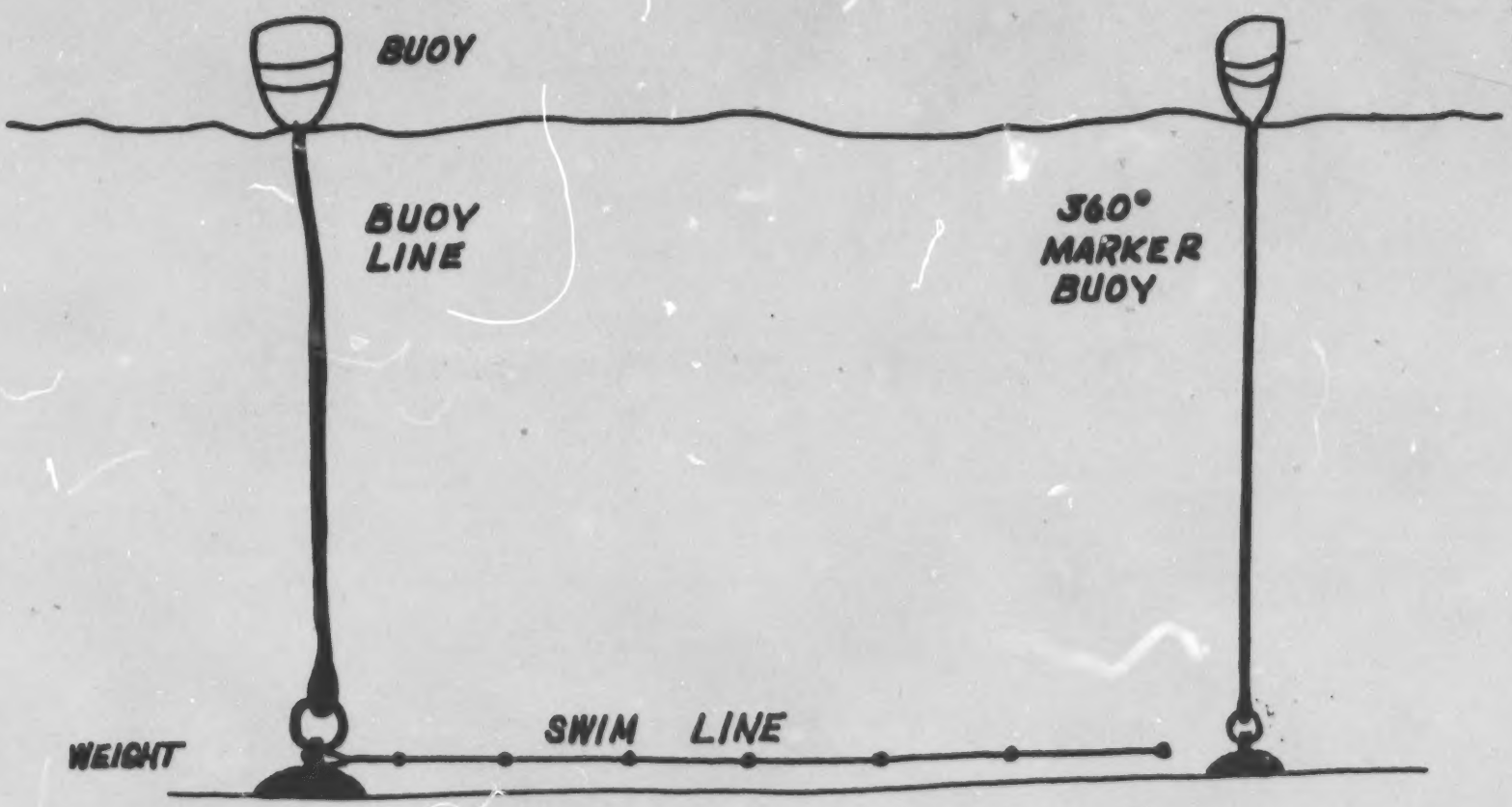
LINE-PULL SIGNALS

7 PULLS – ON/OFF SEARCHING SIGNALS

1 PULL – STOP. SEARCH WHERE YOU ARE.

2 PULLS – WITH STRAIN, COME TO TENDER; WITH SLACK, BACK OUT.

3 PULLS – MOVE



CIRCLING LINE SEARCH

423

INFORMATION SHEET 4-9-41

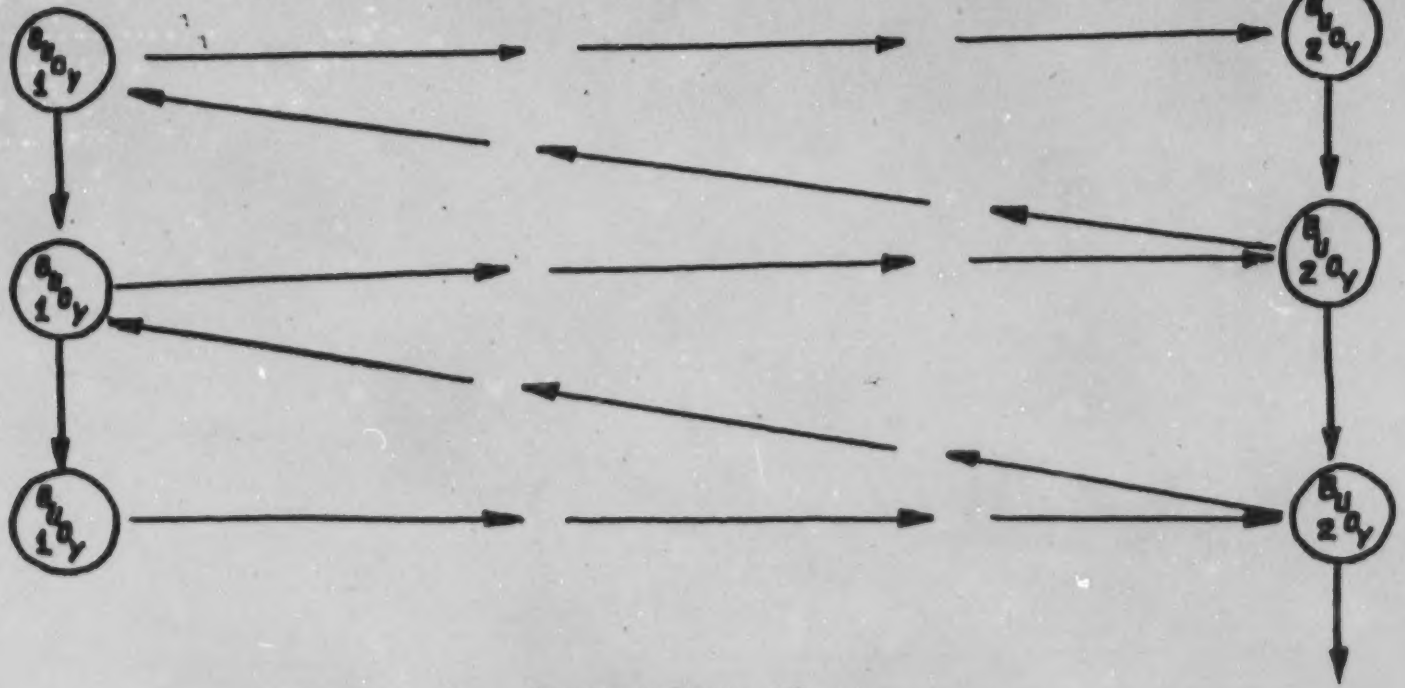
424

JACK STAY SEARCH

441

412

JACK STAY SEARCH (RECTANGULAR)



INFORMATION SHEET 4-9-61 424

JACK STAY SEARCH
(CIRCULAR AREA)

ASSIGNMENT SHEET 4-9-1A

TITLE: Night Bottom Search

LESSON TOPIC OBJECTIVES

Terminal Objective
1. When the student completes this course, he will, in open water, at night, using open circuit SCUBA, as a member of a two-man team, recover a specified object from a depth of at least thirty (30) feet using a circling line, within thirty (30) minutes.

Enabling Objectives
1. Orally define terms used in circling line, jack stay and surface tended methods of bottom searching using open circuit SCUBA.

2. Orally explain the usage of the circling line, jack stay and surface tended methods of searching.

3. Demonstrate procedures for assembling equipment and setting a circling line.

4. Using circling line and jack stay techniques, conduct searching operations during daylight hours, recovering a specified object from the bottom.

5. Use proper surface tended searching procedures and signals during open circuit SCUBA Diving training activities.

STUDY ASSIGNMENT

U.S. Navy Diving Manual, Volume I, para. 6.4.6.2

STUDY QUESTIONS

1. The primary method for searching on the bottom is:

2. If a diver makes a full search using a distance line (circling line), but has not yet found the object, what should be done next?

3. What is done once the object of the search is located?

428
JOB SHEET 4-9-LJ

TITLE: Circling Line Search

INTRODUCTION

This is one of three searching projects you will complete during your SCUBA course. The circling line is a very effective technique for searching small to intermediate size areas using one diver.

REFERENCES

U.S.Navy Diving Manual, Volume I

EQUIPMENT AND MATERIAL

Bathing Suit, Open Circuit SCUBA Face Mask, Swim Fins, Life Vest, Knife, Flare, Cylinders, Regulator, Depth Guage and Wrist Watch. Wet Suits may be worn if water temperature is below 78° or water is polluted.

Circling Line equipment - one clump, buoy line, buoy and swim line

JOB STEPS

1. Diver dresses in open circuit SCUBA equipment.
2. Enter water and swim to buoy carrying swim line.
3. Give O.K. Signal and descend on buoy line.
4. On arrival at clump, attach swim line.
5. Move to first knot and complete a 360° sweep.
6. Move to second knot and complete a 360° sweep.
7. Continue until object is found.
8. Upon finding object, attach a line and bring it to the surface.
9. Come out of the water bringing object of search.

SELF TEST ITEMS

1. Are you staying on the bottom during your searching pattern?
2. Are you searching all the area between where you are now and your previous position?

JOB SHEET 4-9-2J

TITLE: Night Bottom Search (Surface Tended Circling Line)

INTRODUCTION

This practical evolution is your Terminal Objective so far as searching procedures are concerned and a BUPERS Qualification Factor for SCUBA Divers as well. It is made even more interesting by adding the psychological factor of darkness. The procedures are the same, however, so just remember what you've learned and you'll have no problems. You will be tended from the surface during this evolution, so be sensitive to the signals of your tender, and ANSWER ALL SIGNALS.

REFERENCES

U.S.Navy Diving Manual, Volume I

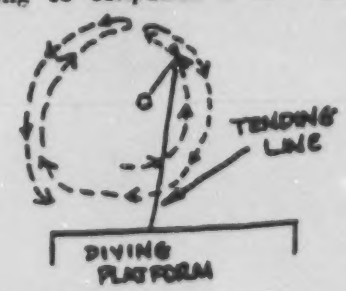
EQUIPMENT AND MATERIAL

Bathing Suit, Open Circuit SCUBA Face Mask, Swim Fins, Life Vest, Knife, Flare, Strobe Light, Cylinders, Ragulator, Depth Guage, Wrist Watch and Diving Light. Wet Suits may be worn if water temperature is below 78° or water is polluted.

Circling Line Equipment - buoy, buoy line, clump and swim line. Tending line.

JOB STEPS

1. Diver dresses in open circuit SCUBA equipment.
2. Attach tending line around divers waist.
3. Enter water and swim to the buoy, carring swim line.
4. Give proper signals (O.K.) and line-pull signals and descend to bottom.
5. On arrival at clump, attach swim line.
6. Move to first knot, and signal tender that you are on the bottom.
7. Tender will put diver on searching signals (7 pulls).
8. Begin swimming to complete a 360° sweep, thus:



9. Turning at the top of the 360° sweep does not allow the tending line and buoy line to become entangled. Be sensitive to tender's signals.

10. Continue swimming and moving out on knots until object is found.

11. Remove diver from searching signals.

12. Diver attaches a line to the object, gives proper signals and comes to the surface.

13. Come out of the water, bringing the object.

SELF TEST ITEMS

1. Are you responding quickly to tender's signals?

2. Are you covering the entire area between where you are now and your previous position?

JOB SHEET ~~8-9-4~~J

TITLE: Jack Stay Search

INTRODUCTION

This final practical searching evolution is best used when searching a large area. In this particular evolution, two divers are used although the jack stay can be readily used with one diver on a line, or several divers on a line. The important thing to remember when completing the jack stay is that the clumps must be moved in the same direction in order to maintain the rectangular pattern. It is easy to become confused on this, so think!

REFERENCES

U.S.Navy Diving Manual, Volume I

EQUIPMENT AND MATERIAL

Bathing Suit, Open Circuit SCUBA Face Mask, Swim Fins, Life Vest, Knife, Flare, Cylinders, Regulator, Depth Guage and Wrist Watch. Wet Suits may be worn if the water temperature is below 78° or water is polluted.

Jack Stay Equipment: 2 buoys, 2 buoy lines, 2 clumps, swim line.

JOB STEPS

1. Diver dresses in open circuit SCUBA equipment.

2. Enter water and swim to buoy #1.

3. Signal O.K. and leave surface.

4. With one diver on each side of the swim line, holding to swim line, commence swimming to buoy #2.

5. Upon arrival, move buoy #2 in the directinn of the search.

6. Swim back to buoy #1, searching all the way.

7. Move buoy #1 in the direction of the search and the same distance that buoy #2 has been moved.

8. Swim to buoy #2, searching all the way.

9. Continue this until object is found.

10. Attach a line to the project and bring it to the surface.

11. Standby to have the workboat pick up divers.

SELF TEST ITEMS

1. Are you moving both buoys in the direction of the search and approximately the same distance?

2. Are you communicating and coordinating your efforts with your partner?

INFORMATION SHEET 4-10-1I

TITLE: Underwater Hull Inspection

INTRODUCTION

This information sheet is designed to provide you with information on underwater hull inspection, a primary function of open circuit SCUBA diving. Material contained herein has been extracted from Volume 1, Underwater Work Techniques Manual. A thorough understanding of this information is essential in order that you can proceed through the practical evolution associated with it, as well as relate it to fleet diving jobs you will encounter following graduation from this course.

REFERENCES

U.S. Navy Underwater Work Techniques Manual, Volume 1

INFORMATION

General: Although active fleet ships have a wide variation of hull sizes and configuration, hull inspections are generally quite similar in procedure. It is possible to describe a technique for hull inspections applicable in most respects to all ships. As is true in the case of all underwater tasks, thorough planning is the key to successful execution of the job. This is especially important in the case of hull inspections since the entire underwater hull and all appurtenances are included, with most of the ship's departments involved. Accordingly, the preparation of the plans in written form is especially desireable.

Task: Underwater hull inspection involves the examination of the entire exterior underwater hull and appurtenances to determine the condition and the need for repairs. When available, it includes closed circuit television coverage of the inspection to assist the evaluation of the inspection.

When tidal currents are not a factor, the inspection may start at the stern or at the bow depending on preferences or physical conditions. When tidal current is a factor, the direction is chosen on the basis of facilitating the work and providing the best security for the diving team and the boat. In this description, the inspection is started at the stern because this is the preference of most tender and repair ship divers. Two divers are usually used, each inspecting half of the ship from stern to bow and with one diver working to port and the other to starboard.

The divers will generally take their air supply from the air flasks in the boat, in a fleet job. This is a matter of equipment availability, condition

of the equipment, boat storage, working space and preferances.

Technique: Prior to beginning inspection, the past underwater hull history should be reviewed with particular attention to previous paint conditions, gouges, dents, scrapes, appurtenances and any other points requiring scrutiny.

(1) Tag-out procedure
(2) Provide Lights as required

Rudder:

Take rudder clearance measurements with inside calipers for comparison with previous readings to determine sag. Measurement is made between the forward uppermost part of the rudder and the nearest hull surface. See illustration for representative examples of clearances.

Check the rudder plugs. Sometimes there are four, sometimes two-one at the top and one at the bottom. Insure that the plugs are in place and secure.

Check the overall physical appearance for cracks in the welds, cracks in rudder surfaces, gouges, scrapes, and any marks which indicate the rudder has contacted some foreign object.

Sound the rudder for possible flooding by tapping on the surface. (Secure plugs and a good physical appearance should indicate that there has not been any flooding, but the tapping test provides added insurances).

Check the rudder post retainer ring bolts with their associated safety wiring. These should be secure since they retain the ring which supports the packing gland around the post.

Propellors:

Check the dunce cap to insure that it is secure in place.

Check the cover plate halves aft of the propeller for their physical appearance and security.

Locate the eyebolt-fitting plug in the hub of the propeller. Insure that the plug is in place and secure. Use this plug as a standard or zero point for numbering the blades on the propeller. Number each blade in succession clockwise as the propeller is viewed from the stern towards the bow. The first blade is #1, the next is #2, and the next #3, and so forth, until all blades are numbered. The purpose of numbering the blades is to compare the previous reports on blade conditions with the current inspection findings.

Check the overall physical appearance of each blade starting with #1. Inspect the peripheral edge for nicks, curls, chips, cracks or other apparent

damage. Use the ruler to measure apparent damage as practicable.

Inspect the face and back for cavitation effects. These effects can be identified by little pocked holes on the blade surface.

Check the rope guard forward of the propeller for security in place and corrosion.

Struts to Stern Tubes:

Check the external primary strut housing and primary strut for apparent damage, such as gouges, nicks, cavitations, etc.

Several types of ships have zincs located on the hull above the V-shape of the main strut running fore and aft. As the inspection progresses from the propellers, check the zincs. (Zincs may be bolted on or welded in place). Deterioration is usually most severe at the after end. Note the percentage of zincs remaining.

Check the fairwater halves at the forward end of the primary strut for rigidity, security and any apparent damage. Fairwaters are in two halves and are usually secured by screws or welded or both.

Swim forward on the shaft taking constant note of the Protective Rubber Coating (PRC) conditions. This coating may be sprayed rather than wrapped like tape.

Inspect the fairwater aft of the secondary strut in the same manner as the inspection of the other fairwater in the step above.

Inspect the external secondary strut housing and secondary strut. This is a repeat of the first step of strut inspection.

Repeat the step above for inspection of the fairwater forward of the secondary strut housing.

Continue up the shaft and check the PRC condition all the way to the stern tube fairwater.

Check the fairwater on the stern tube, as above.

Inspect the external housing of the stern tube. Check the dead lights in the stern tube to see if it is clear within the tube. Dead Lights are oblong holes which have a race track shape. (Some ships do not have dead lights).

Note:

If one diver is conducting the inspection, duplicate steps for the

rudder, propeller, and struts on the opposite side at this time.

Regardless of the number of propellers (1 or 4), the number of struts (1 or 2) or even if the propeller is configured directly to the hull, the sequence indicated for the rudder, propeller and struts need be modified only to the extent of eliminating those steps which are not applicable.

Engineering Underwater Space:

Prior to diving for inspection of engineering underwater spaces, check again to insure free water around the hull for diver safety. A minimum positive clearance of two feet should be assured. This clearance is not a problem in those situations where a ship is at anchor or "Med" moored (stern to the pier) or nested together with camel standoffs between the nested ships.

Inspect the bilge keel. The illustration shows that the bilge keel is generally located in the center half of the ships, usually extending from the after most engineering fireroom forward to the area abreast of the ship's bridge area. Check the bilge keel for apparent damage. The leading or forward edge usually is the part which is most susceptible to roll back or damage. As the inspection progresses along the bilge keel, check for the material condition of the zincs. In some cases, zincs may be at either end, or one end only, or in the middle, or just above the bilge keel and parallel to it. Note the percentage of zincs remaining.

Next, proceed to the vicinity of the main scoop injection and locate it by having a member of the ship's force sound the hull with a slow, steady tapping noise from within. Check for marine growth or anything which may foul the gratings. Check the gratings for security.

Repeat the same procedure for the main circulation pump suctions.

Inspect any other hull openings in the engineering spaces as specifically requested by the ship or which may be seen along the inspection route. Note: If only one diver is performing the inspection (not in school situation) duplicate the Engineering Underwater Inspection for the otherside, including bilge keel and zincs. Then proceed forward to the bow area to inspect the sonar dome, as applicable.

If two divers are inspecting, one diver proceeds to the sonar dome on the side he is inspecting. The other may secure.

Sonar Dome (As applicable):

While proceeding forward to inspect the sonar dome, locate the draft markings on the bow. Follow the markings downward to the sonar dome at the keel. Inspect the dome. Check the face, the bottom, the port and starboard sides for general freedom from growth, scratches, marks and damage. Also

check the condition of the fairing strip where bolts secure the dome to the hull. The older types of sonar are bolted to the hull; the newer models are either welded to the hull or configured as part of the hull at the bow. Note: If the sonar dome is configured to the hull at the bow, swim forward from the bilge keel to the ship's keel. Inspect the keel for bad growth, peeling or loose paint forward to the hull configured sonar.

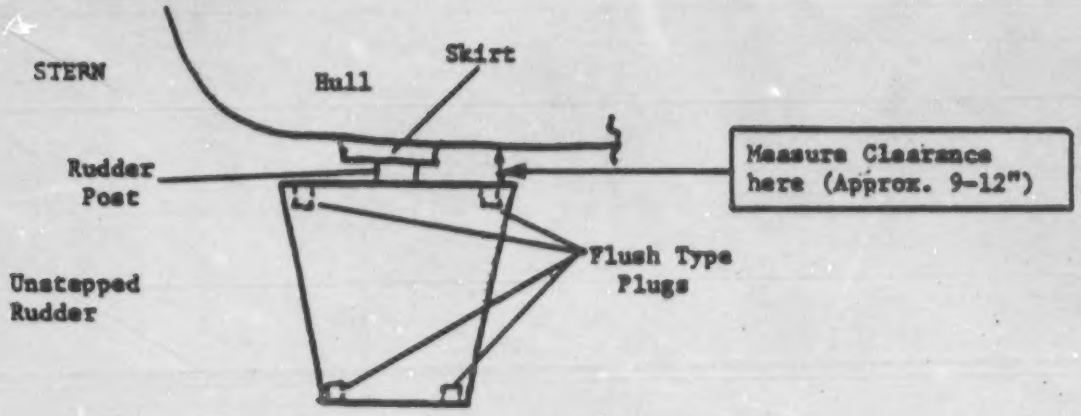
Inspect the hull configured sonar dome. Check the face, the bottom, the port and starboard sides for general freedom from growth, scratches, marks, pitting and other apparent damage.

Ship's Keel and Stem

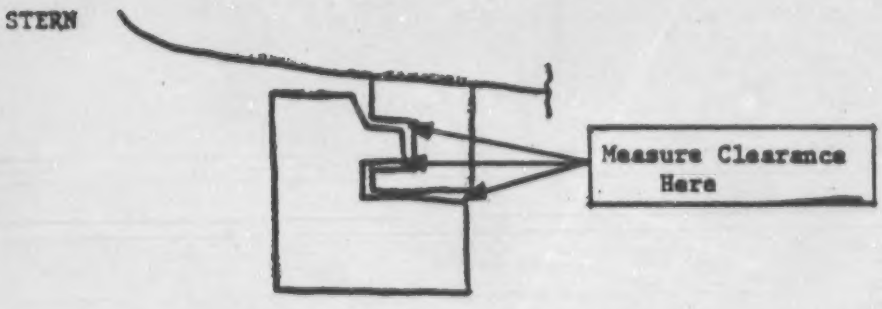
When the keel mounted sonar dome inspection is completed, extend forward and swim alongside the keel, inspecting for bad growth, peeling or loose paint.

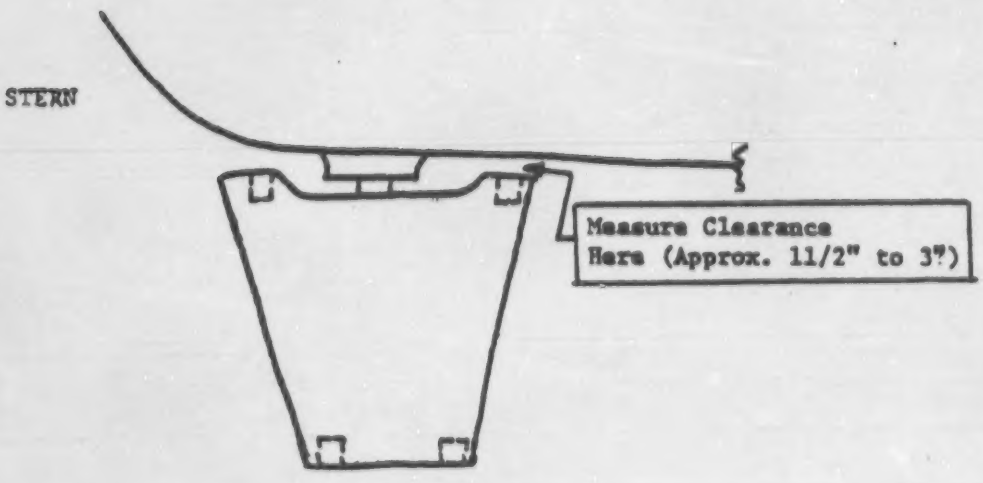
Follow the keel up to the stem. Inspect the stem for any distortion or other apparent damage. Inspection is completed; clear the water.

INFORMATION SHEET 4-10-61



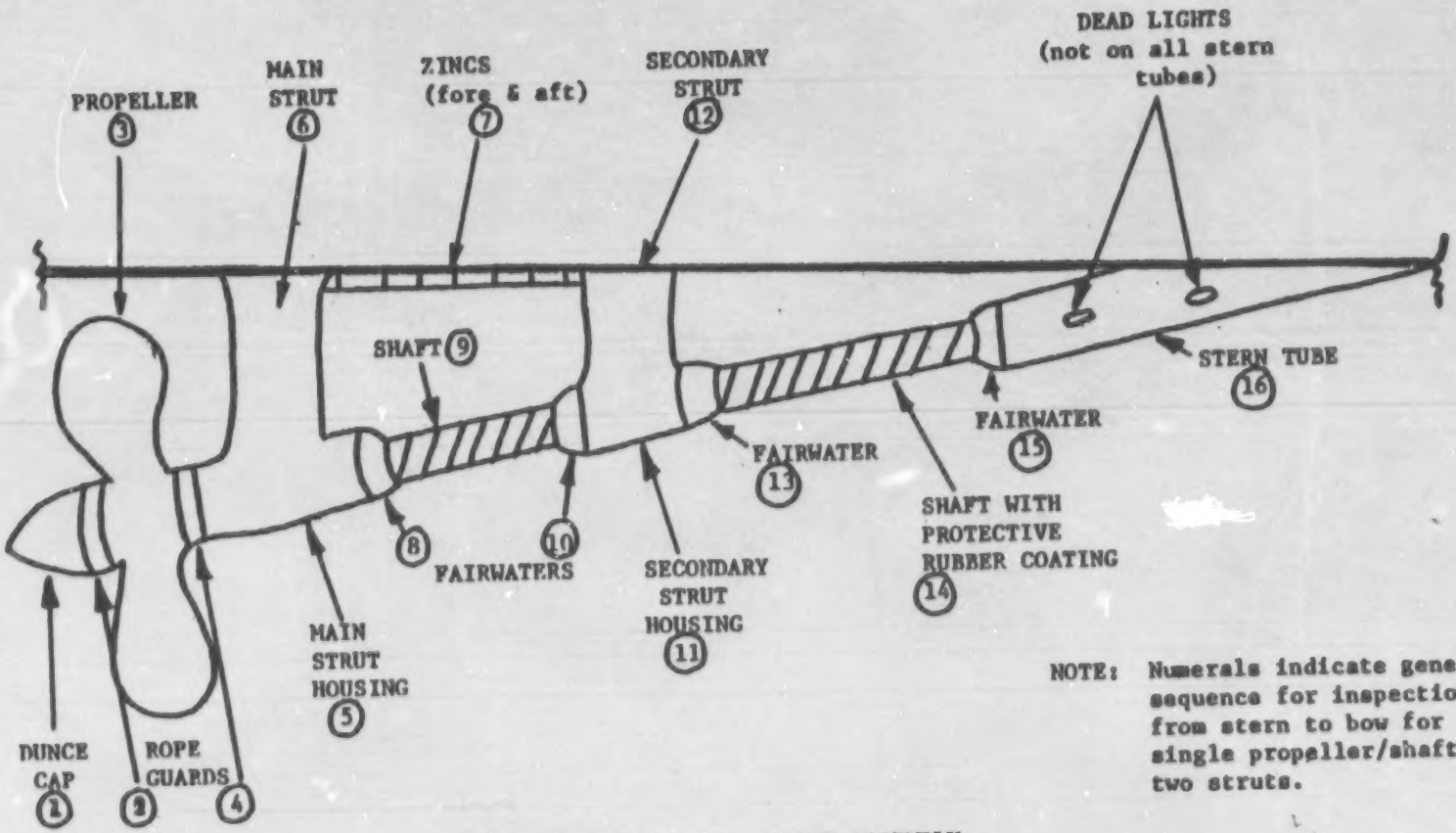
UNSTEPPED RUDDER





STEPPED RUDDER

EXAMPLES OF RUDDER CLEARANCES



NOTE: Numerals indicate general sequence for inspection from stern to bow for any single propeller/shaft with two struts.

TYPICAL PROPELLOR - STRUT ASSEMBLY

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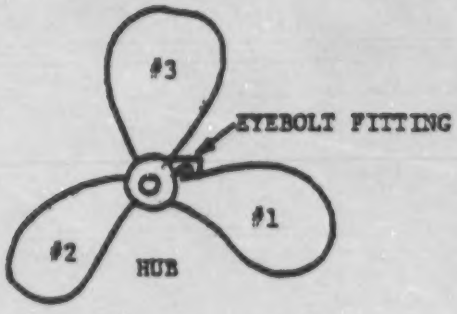
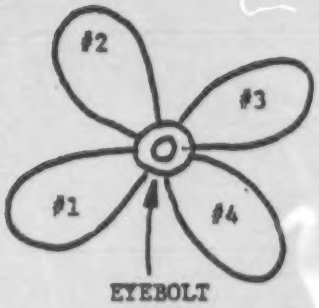
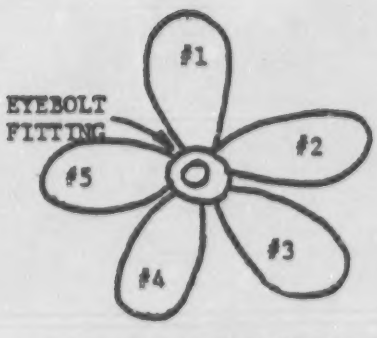


THREE BLADED PROPELLOR

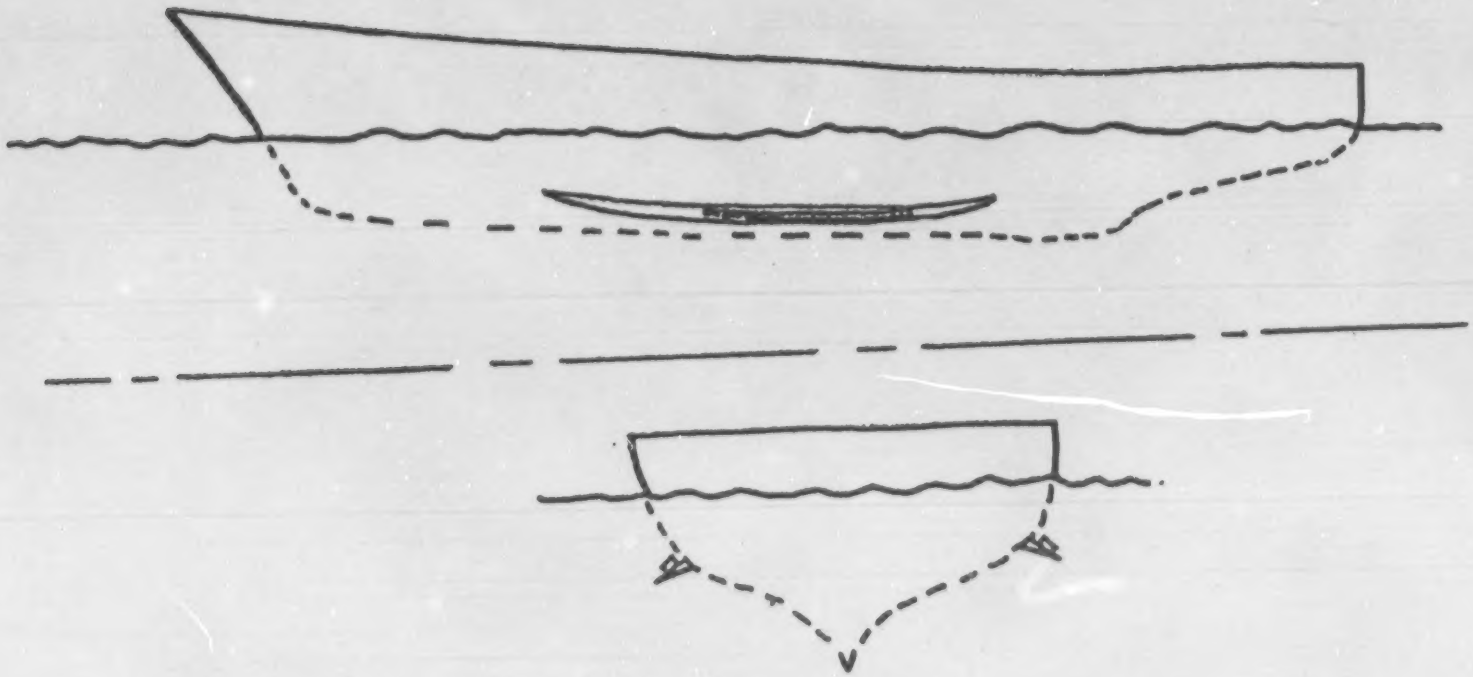


FOUR BLADED PROPELLOR



FIVE BLADED PROPELLOR

EXAMPLES - BLADE NUMBERING



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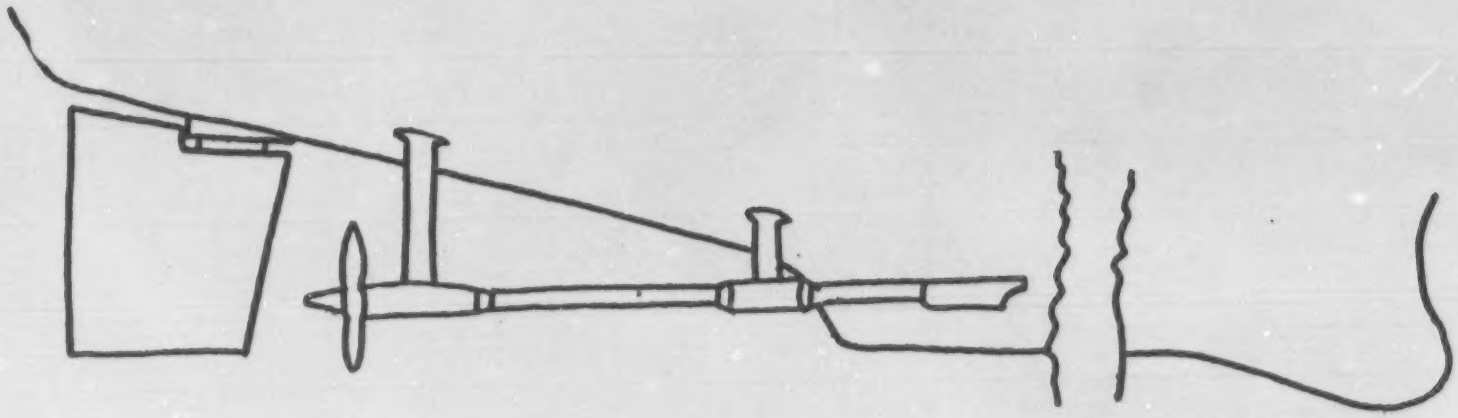
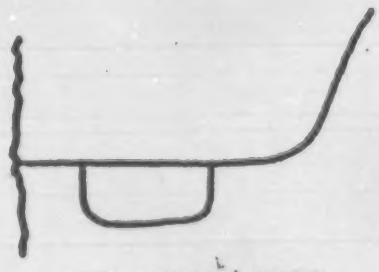
TYPICAL BILGE KEEL LOCATION

461



HULL CONFIGURED SONAR



KEEL MOUNTED SONAR

TYPICAL DLG AND DLGN TYPES U/W HULL OUTBOARD PROFILE

442 ASSIGNMENT SHEET 4-10-1A

TITLE: Underwater Hull Inspection

LESSON TOPIC OBJECTIVES

Terminal Objective
1. When the student completes this course, he will be able to, as a member of a team, in open water, at night, using open circuit SCUBA, conduct a detailed underwater hull inspection of a designated craft. File a written report with the instructor which specifies propellers, shafting, rudders, sonar equipment (if applicable), underwater fittings, and general hull conditions to include applicable measurements, marine growth and other specifics as instructed.

Enabling Objectives
1. Orally explain the function(s) of a detailed underwater hull inspection.

2. Given an illustration of a typical Navy submarine and surface vessel, locate points included in a detailed underwater hull inspection, describing measurements taken and conditions observed during such an inspection.

3. Given a description of a typical surface vessel hull, write an inspection report using proper terminology, measurement data and organization.

4. In open water, in daylight, as a member of a team and using open circuit SCUBA, conduct a detailed underwater hull inspection on an available craft. Provide a verbal report to the instructor.

STUDY ASSIGNMENT

Student Guide Information Sheet 4-10-1I through 4-10-10I, Underwater Hull Inspection.
U.S.Navy Diving Manual, Volume I, Appendix F and J

STUDY QUESTIONS

1. Underwater hull inspections involve examination of the entire

_____ _____ _____ and _____

to determine conditions and the need for _____.

2. An inspection starts at:

   a. the stern.

   b. the bow.

   c. either end when tidal current is not a factor.

ASSIGNMENT SHEET 4-10-2A

3. When tidal current is a factor, hull inspections are normally started at the stern. Why?

4. Rudders are inspected for overall physical appearance for:

a.

b.

c.

d.

e.

5. Describe how a diver would determine which blade of a given propeller is #2.

6. A prime inspection item on the shaft is the PRC. What is the PRC? How is it put on the shaft?

7. What are dead lights?

8. Prior to diving for inspection of engineering underwater spaces, check to insure free water around the hull for diver safety. A minimum positive clearance of _____ feet should be assured. This is not a problem when a ship is:

a.

b.

9. The bilge keel is generally located in the _____ _____ of the ship.

10. The _____ _____ _____ of the bilge keel is the part most susceptible to damage.

11. What does signing the Ship Repair Safety Checklist indicate?

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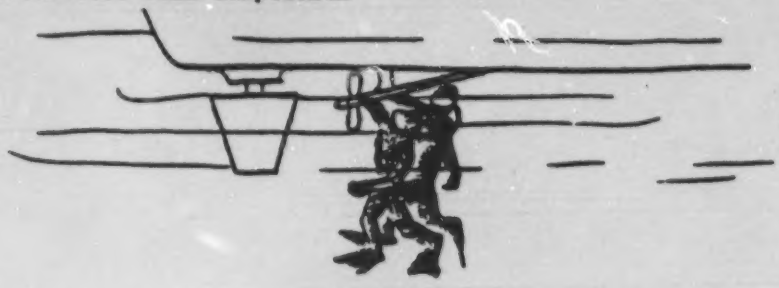
JOB SHEET 4-10-1J

TASK: Underwater Hull Inspection

UNIT: 1. SCUBA
2.
3.



GENERAL DESCRIPTION: Team of divers conduct a detailed underwater hull inspection of an available craft, taking appropriate measurements and filing a subsequent report.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Water		
2. DEPTH	at least 20 feet		
3. EQUIPMENT	1. Open Circuit SCUBA 2. Measuring Instruments (see reverse)		
4. OTHER	1. Night		

STANDARDS:

1. PERFORMANCE	None		
2. TIME	None		
3. EQUIPMENT	1. File an accurate report on specified equipment.**		

** Accuracy may be checked with ship's blueprints.

JOB SHEET 4-10-2J

PROCEDURES

Use the procedures set forth in Student Guide Information Sheet 4-10-1I through 4-10-10I. These are step by step procedures on the conduct of a detailed underwater hull inspection as set forth in the Underwater Work Techniques Manual, Volume I.

WHY DO IT

This gives the student experience in performing a task that he will be required to perform as a diver as well as building his confidence in the use of Open Circuit SCUBA gear through its use and the night environment.

SKILLS NEEDED

Skill in the use of open circuit SCUBA equipment and measuring instruments.

SPECIAL INSTRUCTIONS

Dependent upon the size of the class, it may be necessary to give a team of two divers a specific portion of the underwater hull inspection as opposed to the entire inspection. This does not circumvent the intent of the project so long as both divers are required to perform measurements and to file a report.

446 JOB SHEET 4-10-3J

UNDERWATER HULL INSPECTION REPORT

An inspection of the underwater hull of the USS _____ was performed on _____ with the following conditions noted:

Rudder

Clearance measurement:

Plugs:

Sounding:

Posts:

Surface Condition:

Remarks:

Propeller

Condition of each blade (by number):

Dunce Cap:

Rope Guard:

Remarks:

Bilge Keel

Condition:

Remarks:

Struts:

Condition:

Remarks:

JOB SHEET 4-10-4J

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Fairwaters

Condition:

Remarks:

Stern Tube:

Housing:

Remarks:

Sea Chests:

Remarks:

Zincs

Missing:

Deteriorated:

Intact:

Remarks:

Sonar Dome (as applicable)

Surface condition:

Welded Seams:

Remarks:

Hull

Paint:

Growth:

Dents, damage:

Remarks:

General Remarks:

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signed:_____

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INFORMATION SHEET 4-11-1I

TITLE: General Safety Precautions

INTRODUCTION

SCUBA Diving is the most dangerous form of diving engaged in by the U.S.Navy. This is a simple statement, but one that cannot be overemphasized. SCUBA Diving is the most dangerous form of diving engaged in by the U.S.Navy. It is important that you, the diver, keep this thought in mind at all times. When the time comes that you feel you know the equipment "inside out" and can use it - "no sweat" - you've lost respect for it and are in grave danger.

Safety, in all types of diving, is an integral phase of all diving theory, systems and practical work. It is difficult to separate items in order to enumerate specific safety items in a classroom situation. Therefore, many items have and will be covered during the classroom/practical evolutions concerned with a particular piece of equipment item or skill. The safety items covered in this lesson topic are those not specifically elaborated upon elsewhere.

REFERENCES

U.S.Navy Diving Manual, Volume I
Diving and Salvage Safety Notes 1971/72

NOTETAKING SHEET 4-1-1N

TITLE: SCUBA Theory

REFERENCES

U.S.Navy Diving Manual, Volume I
NAVSHIPS INST. 9940.16A
U.S.Navy Operations Handbook

NOTETAKING OUTLINE

I. Review

A. Principles Laws of Diving

1. Boyle's Law

a. Definition:

b. Application to SCUBA:

2. Charles' Law

a. Definition:

b. Application to SCUBA:

3. Dalton's Law

a. Definition:

b. Application:

4. Archimede's Principle

a. Definition:

b. Application to SCUBA:

NOTETAKING SHEET 4-1-2N 450

B. Review of Diving Terminology

1. Composition of Air

a. Nitrogen -

b. Oxygen -

c. Carbon Dioxide -

d. Argon (inert) -

e. Rare Gases-

2. Pressure -

3. Atmospheric Pressure -

4. Gauge Pressure -

5. Absolute Pressure -

6. Partial Pressure -

7. Absolute Temperature -

8. Bottom Time

9. Decompression Time -

10. Total Time -

11. Surface Interval -

12. Residual Nitrogen Time -

13. Equivalent Single Dive Time -

14. Repetitive Dive -

15. Decompression Stop -

II. SCUBA THEORY

S_____ C_____ U_____ B_____ A_____

A. Advantages

1. _____ deployment

2.

3. Minimum _____

4. Excellent _____ and _____ mobility

5. _____ bottom disturbance

B. Disadvantages

1. _____ endurance - both _____ and duration.

2. Breathing _____

3. Limited _____ protection

4. Influenced by _____

a. maximum _____ knot

5. Lack of _____ with topside

C. Three (3) Types of SCUBA

1. _____ _____

2. _____ _____ _____

3. _____ _____

D. Open Circuit SCUBA

1. Definition:

2. Advantages compared to other SCUBA types

a.

b.

3. Disadvantage compared to other SCUBA types

a.

4. Restrictions

a. Depth

(1) Working -

(2) Maximum -

(3) Emergency -

(a) Cardinal Rule: NEVER MAKE A DIVE REQUIRING _____ IN SCUBA.

b. Diving Team Required

(1)

(2)

(3)

(4)

E. Semiclosed Circuit SCUBA

1. Definition:

2. Advantages compared to other SCUBA types

a.

b.

3. Disadvantages compared to other SCUBA types

a.

4. Restrictions

a. Work Limits - HeO2

(1) Normal -

(2) Maximum -

b. Work Limits - N2O2

(1) Normal -

(2) Maximum -

NOTETAKING SHEET 4-1-5N

F. Closed Circuit SCUBA (O2 - Emerson)

1. Definition:

2. Advantages compared to other types of SCUBA

a.

b.

3. Disadvantages compared to other types of SCUBA

a.

b.

4. Restrictions

a. Work Limits

(1) Normal -

(2) Maximum -

G. General Uses of SCUBA

1. Inspections -

2. Searches -

3. Light Underwater Work -

4. Clandestine Operations -

H. Most Common Cause of SCUBA Casualties

1. _____ due to:

a.

b.

c.

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NOTETAKING SHEET 4-1-6N

I. Buddy System

1. _____ or _____ contact

2. If a single diver is being used, he should be _____ from the surface.

3. _____ lines may also be used for two divers if _____ seem particularly _____.

J. Select Proper Decompression Tables

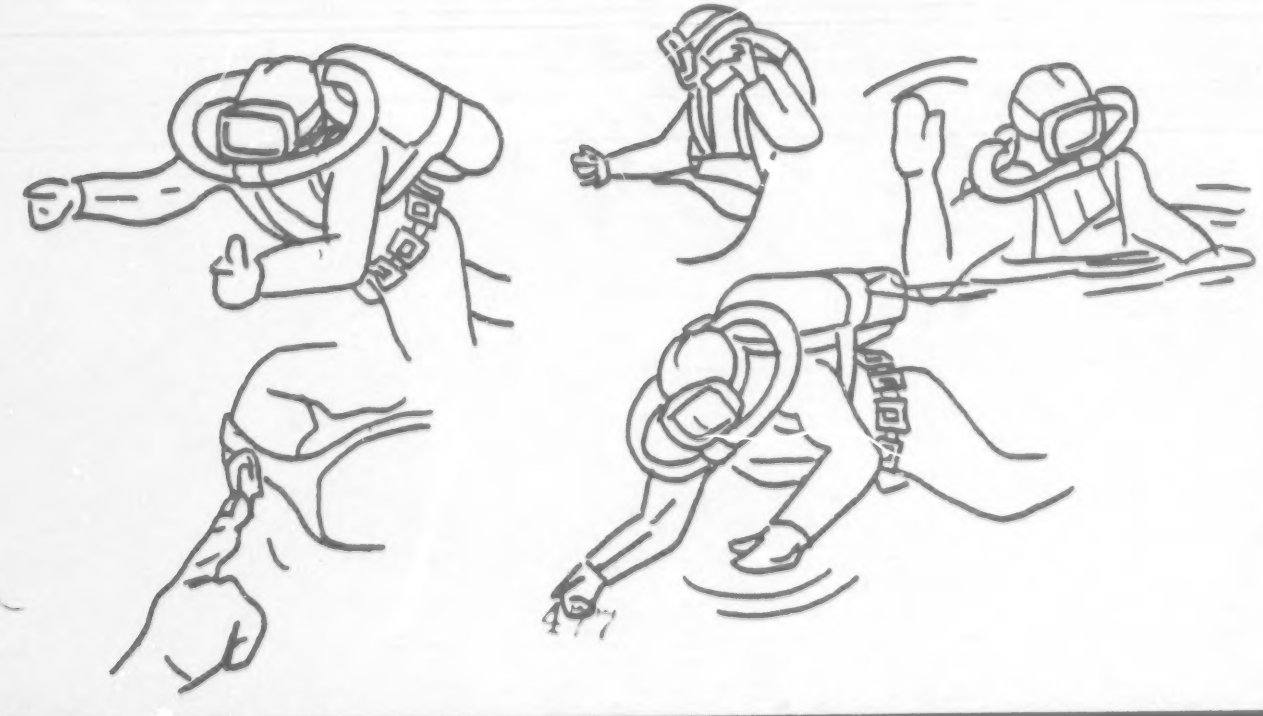
1. SCUBA Dives involving decompression are _____.

2. SCUBA dives involving decompression should _____ be made except as a _____ _____.

3. The total time and depth of a SCUBA dive (including _____) must never exceed the _____ of the _____ in use disregarding any _____.

NOTETAKING SHEET 4-1-7N

K. VISUAL HAND SIGNALS



456 NOTETAKING SHEET 4-2-1N

TITLE: Open Circuit SCUBA Underwater Accessories

REFERENCES

U.S.Navy Diving Manual, Volume I
NAVSHIPS 9940.16A

NOTETAKING OUTLINE

A. All equipment used in Navy Open Circuit SCUBA Diving must be approved and published in NAVSHIPS _____.

1. Wet Suits

a. Made of closed cell _____.

b. Protects diver from:

(1)

(2)

(3)

(4)

c. Proper fit:

d. Principle:

e. After use, should rinse wet suit with _____ _____.

f. Hints:

(1) Remove _____

(2) Weakest Points are around _____

(3) Should apply _____ to zippers regularly.

2. Life Vest

a. Modified UDT Life Preserver

(1) _____ gram CO2 cartridge

(2) oral _____ tube

(3) _____ inflation device

(4) _____ pounds _____ buoyancy at _____ feet.

(5) not effective deeper than _____ feet.

(6) main function is to:

(7) the only item of SCUBA not secured with a _____ _____.

b. Mk III Yoke Type

(1) _____ _____ gram CO2 Cartridges

(2) _____ oral inflation tubes

(3) _____ automatic inflation devices

(a) one for each _____

(b) two _____ per inflation device.

(4) _____ pounds positive buoyancy at _____ feet.

(5) _____ pounds _____ _____ on the surface.

(6) If 18 gram CO2 cartridges used, vest has _____ pounds positive buoyancy at _____ feet.

(7) No _____ release.

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NOTETAKING SHEET 4-2-3N

3. Knife

a. Made of _____ _____ _____.

b. Handle of _____, _____ _____, or _____.

c. Prefer double edged; one knife edge, one _____.

d. Scabbard should hold the knife with a _____ but easily _____ lock.

e. May be worn:

Never on the _____ _____.

4. Mark 13, Mod 0 Flare (Day/Night): preferred type

a. Used only in case of _____.

b. Smooth end (_____) emitts _____ seconds of red-organge _____.

c. Ring of _____ _____ (night) emitts _____ seconds of brilliant _____ _____.

d. Never carry the flare by the _____ _____.

5. Strobe Light

a. Emitts a bright _____ approximately once each _____.

b. Used only in case of _____.

c. _____ covered push switch.

6. Compass

a. Used for _____ _____.

b. May be worn on _____ or on _____ _____.

c. Some models are _____ _____ hazards.

d. Use a good _____ to prevent loss.

NOTETAKING SHEET 4-2-4N

7. Depth Gauge

a. Used to determine _____ of dive.

b. Must be accurate within _____ ft. at 50 ft. and _____ ft. from 50-300 ft.

c. Checked for accuracy

(1) every _____ months

(2) when a _____ is suspected

(3) before _____ on a dive if _____

d. Phosphorus dial for easy reading.

(1) _____ hazard.

8. Watch

a. _____ dial for easy reading in limited visibility.

b. _____ _____ for indicating elapsed time of the dive.

c. watch and _____ _____ should be worn on the same _____ as they are closely related.

9. Diving Light

a. Used to _____ diver's job or way.

b. Must be _____ and _____ tested.

10. Face Mask

a. Primary Purpose:

b. Secondary Purpose:

460 NOTETAKING SHEET 4-2-5N

c. Lens must be made of _____ or _____ safety glass.

d. To insure proper fit, _____ mask to face, _____ gently and remove hand. Mask should _____ _____ _____.

e. _____ straps are used to secure the mask.

11. Swim Fins

a. Increase the _____ of the diver.

b. Various degrees of _____ and _____ of blade.

c. Two basic types of blades

(1)

(2)

d. Fixed _____, _____ strap and _____ socket.

e. Normally wear _____ _____ (booties)

f. Blades too small or too large _____ _____ _____.

12. Snorkel

a. _____ tube which allows the diver to swim _____ _____ in the water. Less _____.

b. Use for _____ in _____ depths. (Conserve _____)

c. Variety of approved models.

13. Weight Belt

a. Used to _____ the _____ buoyancy of most divers and the buoyancy of the _____ _____.

b. Must have a _____ _____ buckle operable by either _____.

c. Made of _____ and _____ _____ fabric.

d. Weights should have _____ edges so as to not _____ diver's skin or _____ protective gear.

e. Weights come in various _____ and _____.

f. Take time to carefully _____ _____ weight belt (for near _____ buoyancy)

g. Weight belt most often lost during water _____ or _____.

14. Buoy and Buoyline

a. Used in _____ _____ or when _____ of the diver is in question.

b. Never attach to a piece of equipment which may be _____.

c. May be of any _____ material; painted _____, sealed _____, life _____ or _____ tube.

(1) Should be brightly _____ with a _____ _____ attached.

15. Buddy Line

a. _____ to _____ feet long.

b. A must at _____ or in conditions of _____ _____.

462 NOTETAKING SHEET 4-2-7N

c. Any Line used in SCUBA operations should be:

(1)

(2) have _____ or slightly _____ buoyancy.

16. High Pressure Gauge

a. _____ to 3000 PSI

b. Has a _____ fitting to attach to _____ _____.

c. Has a relief _____ to bleed of _____ after securing _____ _____.

d. Should be _____ or checked with other _____ _____ gauges periodically.

NOTETAKING SHEET 4-2-[illegible]

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TITLE: Open Circuit SCUBA Cylinder and Manifold Assembly System

REFERENCES

U.S.Navy Diving Manual, Volume I

NAVSHIPS 0994-[illegible]-0100

NOTETAKING OUTLINE

A. Cylinders - Steel, High Pressure

1. Filled with _____ _____

a. Never fill with _____

b. _____, diver poisoning.

2. One or more used.

3. Working Pressure - _____ PSI

4. Approximate Volume - _____ cu ft at _____ PSI

5. Under _____ Regulations (formerly I.C.C.)

a. Must be hydrostatically tested every _____ years.

b. Tested to _____ PSI or _____ times the working pressure.

6. Information stamped on the bottle neck:

a. _____ _____

b. _____ number

c. Month/Year of most recent _____ _____

d. _____ _____ symbol

7. All cylinders are under the _____ _____ System.

a. Annual Requirement - _____ or in use

(1) _____ broken down and internally _____.

(2) _____ as necessary.

b. Bottles in use - inspect _____

(1) Maintain at _____ PSI minimum

B. Cylinders, Aluminum, High Pressure

1. Filled with _____ _____

a. Never fill with _____.

b. Explosion, diver _____

2. One or more used

3. Working pressure - _____ PSI

4. Approximate Volume - _____ cu ft at _____ PSI

5. Under _____ Control

a. Must be _____ tested every _____ years

b. Tested to _____ PSI or _____ times the working pressure.

6. Information stamped on cylinder

a. Test _____

b. Working _____

c. _____ number

d. _____ test date

e. _____ Test

f. Actual measured _____ _____.

g. Minimum _____ _____ Permitted

7. Cylinders in use - inspect _____

a. Maintain at _____ PSI minimum

NOTETAKING SHEET 4-2-10N

C. Test/Inspection of Cylinders

1. All cylinders - in use or storage, broken down and inspected every _____ months.

2. If water or particulate _____ is suspected to have entered the cylinder, it must be _____ before _____ _____.

3. Inspection, _____ and testing procedures - NAVSHIPS INST. _____

4. Safety Regulations - High Pressure Gas Cylinders

a. NAVSHIPS Tech Manual _____

b. SCUBA Cylinders, Table _____, U.S.Navy _____ Manual

5. Inspection must be a _____ _____ evolution.

a. _____ down cylinders

b. Remove _____

c. _____ visually

d. Look for:

(1)

(2)

(3) Visual accumulation of a _____ substance

(4) Inspect _____ and O-ring _____ surface.

6. Cleaning Procedure

a. Place washed _____ _____ and _____ in cylinder.

(1) _____ qts of _____ and 2qts _____ in steel cylinder.

(2) _____ qts of _____ and 2 1/2 qts of _____ in aluminum cylinder.

b. Roll Cylinder about its _____ until interior is _____.

(1) Do not try to remove _____ or protrusions.

(a) If _____ are present, _____ cylinder.

(2) If cylinder will not clean up, _____ it.

c. Once clean

(1) Empty and _____ _____ thoroughly

(2) Rinse with warm _____ _____.

(3) Dry with clean _____ _____.

7. Hydrostatic Test

a. Test Facilities

(1) Commercial Firms - qualified to perform _____ tests.

(2) Authorized _____ _____

b. Test is _____ method

(1) Measures _____ _____

c. All failures must be _____ _____.

8. Replacement of Cylinders

a. Comprehensive _____ _____ must be kept.

b. Previous _____ history and _____ are important factors in determining replacement.

D. Manifold, High Pressure

1. Passes air from _____ to _____.

2. Consists of:

a. _____ valve - on/off valve

b. High Pressure _____ plugs/discs

(1) _____ on single manifold

(2) _____ on twin manifold

(3) Two types

(a) Actual _____ filled plug

1. _____ piece design

2. _____ stamped on the head

(b) Safety disc, plug assembly

1. _____ piece design, safety disc and safety plug

2. Safety discs - _____ coded

a. 2250 PSI Cylinders - _____ blows at _____ PSI

b. 3000 PSI Cylinder - _____ blows at _____ PSI

(c) Never use _____ plugs or discs.

(d) Destroy _____ discs.

(e) PLUGS ALWAYS POINT _____ FROM THE DIVER.

c. Reserve Valve Mechanism

(1) Gives warning of _____ _____ _____.

(2) Provides diver with _____ to _____ safely.

(3) Holds back _____ to _____ PSI

(a) Twin cylinders - _____ cylinder only

(b) _____ loaded check valve.

(c) Manual _____.

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NOTETAKING SHEET 4-2-13M

(4) As air pressure in tank decreases

(a) valve slowly closes

(b) causes regulator to _____ _____ _____.

(c) diver pulls down _____ _____

(d) valve opens - supplying remaining _____ to _____PSI air.

(5) Never assume the reserve _____ _____.

(a) Could be _____ during the working dive.

(b) Could be accidentally _____ earlier.

(6) Divers, in pairs, must _____ immediately if _____ goes on _____ air.

(7) Reserve valve must be down for:

(a)

(b)

(c)

d. Trace air flow - cylinder to regulator

(1) Right Cylinder to regulator

(a) Air exits cylinder via _____ _____

(b) Passes by _____ _____ plug.

(c) From elbow to _____ _____.

(d) Passes up to _____ disc assembly of cylinder _____

NOTETAKING SHEET 4-2-14N

(e) _____ _____ is controlled by cylinder valve.

(2) Left cylinder via reserve assembly

(a) Air exits cylinder via _____ assembly.

(b) If _____ PSI or more, it unseats the disc of the _____ _____.

(c) Flows by _____ disc, and safety _____ plugs.

(d) Flows through the channel housing _____ PSI reserve spring.

(e) Through _____ - holds 500 PSI in place.

(f) Exits reserve valve assembly

(g) Enters _____ _____

(h) Continues to _____ and disc assembly of _____ valve.

(i) Air Flow is controlled by cylinder valve.

(3) Manual override, Reserve Assembly

(a) At 300-500 PSI, spring pushes _____ closed.

(b) To physically override disc, push reserve handle _____.

(c) Reserve stem rotates _____

(d) Pin and Plunger Assembly has _____ grooves.

1.

2.

(e) Reserve stem is in _____ groove - reserve _____

1. This allows spring to hold _____ and _____ assembly away from the disc.

a. 500 PSI spring _____ disc and air flow.

(f) _____ Rotation - Reserve _____

1. Reserve stem in _____ grooved.

2. Pin and plunger assembly is physically holding disc open - allowing _____ _____.

3. Diver is on _____ _____.

E. Repair of Manifold

1. Never attempt repairs on a _____ _____.

2. _____ _____ before starting any repairs.

3. Use _____ manual and correct _____.

a. Do not attempt repairs by _____.

4. Maintain a clean - organized work area.

5. DO NOT USE _____ OR _____ FOR LUBRICATION

a. Use only approved lubricants

(1)

(2)

6. Use _____ and _____ tools.

7. Use correct _____ parts.

8. Always _____ equipment after repairs.

9. TAKE YOUR TIME - - DO IT RIGHT.

NOTETAKING SHEET 4-2-16N

TITLE: Single Hose Regulator

REFERENCES

U.S.Navy Diving Manual, Volume I
NAVSHIPS 0994-008-6100
U.S.Divers Regulator Repair Manual

NOTETAKING OUTLINE

A. Principles of Single Hose Regulator

1. Reduces _____ _____ air to pressure useable by diver at _____.

2. Two Stage Reducer

a. First Stage

(1) Reduces _____ _____ air to constant _____PSI over bottom pressure.

b. Second Stage

(1) Reduces _____ PSI over bottom to exactly ambient _____ _____ at operating _____.

(2) Upon demand, delivers air to _____ _____

(a) Diver inhales - produces imbalance between _____ _____ and ambient _____ _____.

(b) Imbalance acts on _____, opening _____ _____ _____ valve.

(c) Allows _____ to flow to _____.

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NOTETAKING SHEET 4-2-17N

B. Principle Parts

1. First Stage

a. _____ unit.

b. Fastens to _____ by yoke.

2. Intermediate Pressure Hose

a. Delivers _____ PSI air between stages.

b. Male end and o-ring to _____ _____.

c. Female end and o-ring to _____ _____.

3. Second Stage

a. _____ _____ reducing mechanism

(1) Low Pressure _____ _____

(2) Lever

(3) _____

b. Rubber Mouthpiece

(1) Snaps for _____ _____

c. Exhaust Valve - allows _____ out, keeps _____ out

(1) Built into _____ of Second Stage box

(2) Exhaust tube or _____

d. Purge Button

(1) Located on _____ of Second Stage Box

(2) _____ overrides Low Pressure Stage

(3) Physically depresses _____

(a) causes _____ _____ _____ valve to deliver _____.

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(4) Quickly _____ regulator.

C. Air Flow - Single Hose Regulator

1. High Pressure air to Intermediate Air

a. High Pressure air enters through _____ _____.

b. Passes by or through:

(1) High Pressure _____ assembly

(a)

(b)

(c)

(2) High Pressure Seat Assembly _____

(3) High Pressure Seat Assembly (if _____)

(4) Pin and _____

c. Air now at _____ _____ (125PSI)

(1) High Pressure _____ depresses

(2) Diaphragm Spring - preset to _____ PSI tension.

(3) This allows High Pressure Seat Assembly _____ to close High Pressure _____ _____.

(4) Remains closed until pressure drops below _____ PSI

d. Pressure drops below _____ PSI

(1) _____ PSI spring expands, moving _____ and _____ _____ linkage.

(2) Overrides _____ _____ Seat Assembly _____

(3) Pushes High Pressure seat assembly _____

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NOTETAKING SHEET 4-2-19N

(4) Air enters _____ _____ until _____PSI

(5) _____ PSI diaphragm and _____ _____ are depressed.

(6) High Pressure Seat Assembly is closed by High Pressure Seat Assembly Spring.

e. Over bottom Pressure

(1) Controlled by _____ _____ and _____ _____.

(2) By _____ screw

(3) Tension set at _____ PSI

(4) Regulator designed to work at _____ PSI

(5) Attach gauge to _____ _____ or hose - turn _____ _____ to set over bottom pressure.

2. Intermediate Pressure to Breathable Air

a. Air exits intermediate pressure hose via _____ _____ _____ assembly.

(1) Located in _____ _____ _____ box.

b. Breathable air now in Low Pressure _____.

c. Low Pressure Valve assembly (_____ valve)

(1) Inlet nipple - contains Low Pressure _____.

(2) Low Pressure disc and disc retainer assembly

(a)

(b)

(c)

(d)

NOTETAKING SHEET 4-2-20N

(3) Low Pressure _____ _____

(4) Low Pressure _____

d. Diver inhales

(1) Pulls partial _____ in Low Pressure Chamber

(2) Low Pressure _____ collapses toward _____ _____.

(3) Movement pushes _____ on disc _____ assembly.

(4) Disc retainer assembly lifts _____ _____ disc from _____.

(5) Low Pressure flow valve is _____ - air flows to diver.

(6) Diver stops inhaling or exhales

(a) diaphragm _____ to _____ position

(b) Low Pressure spring _____ Low Pressure disc _____ seat.

e. Exhaust Valve

(1) Located on _____ of Low Pressure Stage box

(2) Simple _____ discs.

(3) _____ during exhalation

(4) _____ _____ _____ keeps it closed otherwise.

f. Purge Valve

(1) _____ _____ button

(2) Overrides _____ _____ diaphragm

(3) Opens Low Pressure _____ _____, clears _____.

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NOTETAKING SHEET 4-2-21N

D. Advantages/Disadvantages

1. Advantages

a. Second Stage is always at approximately the same pressure as _____.

(1) Does not have _____ _____ tendency.

b. Purge Valve allows immediate _____.

c. _____ _____ EASIER (purge valve and hose)

d. Reduced _____ _____.

e. Stronger intermediate _____.

f. Generally more rugged piece of equipment.

2. Disadvantages

a. _____ sometimes obscure vision.

b. Susceptible to _____ _____.

E. Repair of Single Hose Regulator

1. Disassemble and Repair

a. Use proper _____ _____ as guide

(1) NAVSHIPS 0994-000-0100

(2) U.S. Divers Regulator _____ _____

2. Tools

a. _____ pressure _____

b. _____ pliers.

NOTETAKING SHEET 4-2-22N

TITLE: Double Hose Regulator

REFERENCES

U.S.Navy Diving Manual, Volume I
NAVSHIPS 394-0065
U.S.Divers Regulator Repair Manual

NOTETAKING OUTLINE

A. Principles of Double Hose Regulator

1. Reduces _____ _____ air to a pressure usable by _____

2. Two Stage Reduction

a. First Stage - _____ _____ Reducing Valve

(1) Reduces _____ _____ air to a constant _____ PSI over bottom pressure.

b. Second Stage - _____ _____ Reducing Valve

(1) Reduces _____ PSI over bottom to exactly _____ _____ pressure at operating depth.

(2) Upon demand, delivers _____ to divers _____

(a) Diver inhales, creating a _____ _____

(b) Forces _____ to move

(c) This opens _____ _____ _____ valve allowing air to _____ to _____.

B. Principle Parts

1. Regulator

a. _____ and _____ _____ located inside regulator box

2. Inhalation Hose

a. _____ side

NOTETAKING SHEET 4-2-23N 478

3. Mouthpiece

a. Relatively watertight _____ into diver's mouth.

b. Contains two _____ valves

(1) Right Side

(a) Allows _____ into mouthpiece

(b) Prevents air from entering into _____ _____

(c) Opens on _____.

(d) Closes on _____.

(2) Left Side

(a) Hose on left side

(b) Channels _____ air back to _____ and out.

1. Has _____ valve in _____ box/end of hose prevents _____ from entering hose.

C. Air Flow - Double Hose Regulator

1. High Pressure Air to Intermediate Pressure

a. Enters _____ _____

b. Passes by:

(1) _____ block

(2) High Pressure _____ Spring

(3) High Pressure _____ Assembly

(4) _____ and _____ Support

c. Air is now in _____ _____ chamber.

d. Pressure reaches _____ PSI

(1) Depresses _____

(2) Diaphragm depresses _____ _____

(3) Allows High Pressure _____ _____ to close High Pressure _____ assembly.

(4) Remains closed until intermediate pressure _____ _____ _____ PSI

e. Pressure drops below _____ PSI

(1) Diaphragm can no longer hold _____ _____

(2) _____ expands, moving _____ and _____ support linkage.

(3) Overrides High Pressure _____ _____, opening High Pressure seat.

(4) Allows High Pressure air to _____ into _____ _____ until _____ PSI is reached.

(5) _____ PSI _____ and spring are depressed.

(6) High Pressure _____ closes High Pressure _____ assembly.

f. Overbottom Pressure

(1) Controlled by _____ _____ and _____ _____

(2) By means of an _____ _____.

(3) _____ tension is set.

(4) Designed to work at 110 PSI

(5) Attach gauge to _____ _____.

(6) Turning _____ _____ sets over bottom pressure.

NOTETAKING SHEET 4-2-25N 480

2. Intermediate Pressure to Breathable Air

a. Air exits intermediate pressure chamber via _____ _____ _____ assembly.

b. _____ _____ is now in the chamber.

c. _____ _____ valve assembly.

(1) _____ _____ _____ assembly.

(2) _____ _____ _____ _____.

(3) _____ _____ lever

(4) Low pressure _____.

d. Diver inhales

(1) Pulls partial _____ in Low Pressure Chamber

(2) Low Pressure diaphragm collapses toward _____ _____.

(3) pushes _____ _____ _____.

(4) Accuates Low Pressure _____ _____.

(5) Low Pressure Valve _____, air _____ low pressure chamber.

(6) _____ returns to normal position.

(7) Low Pressure _____ _____ closes Low Pressure _____

D. Advantages/Disadvantages

1. Advantages

a. Resistant to _____ _____

b. Air in inhalation hose is at a pressure equal to _____ _____ pressure.

(1) Should a rupture occur, _____ _____ would result instead of rapidly depleted _____ _____.

c. _____ exhausted behind diver - doesn't effect _____.

2. Disadvantages

a. Placing _____ _____ below diver causes _____ _____

(1) Affects working position

b. Two hoses offer increased _____ _____.

c. Warm Weather causes _____ _____ (flapper, check valves) to _____ _____.

d. _____ problems with mouthpiece and hoses.

E. Repair of Double Hose Regulator

1. Disassemble and repair

a. Use proper _____ _____

(1) NAVSHIPS _____

(2) U.S.Divers _____ _____ Manual

b. Tools

(1) High Pressure _____ _____ Guide

(2) Over bottom Pressure _____ _____.

(3) Body _____ Wrench

(4) Body wrench/vise

(5) _____ Pliers

482 NOTETAKING SHEET 4-4-1N

TITLE: Planning

REFERENCES
U.S.Navy Diving Manual, Volume I

NOTETAKING OUTLINE

A. The eight (8) Steps in Planning

1. _____ objectives
2. _____ and analyze _____
3. Establish _____ tasks
4. Select _____ technique
5. Select _____ and _____
6. Select and assemble the _____ _____
7. Make final preparations and check all _____ _____
8. _____ operation

B. Define Objectives

1. _____ the operation is being undertaken
2. _____ is to be accomplished

C. Collect and Analyze Data

1. Environmental

a. _____ conditions

(1) _____ messages

(2) charts

(3) _____ books

(4) ships _____

(5) _____ tables

(6) _____ orders

(7) _____ to mariners

b. Underwater Conditions

(1) Influence

(a)

(b)

(c)

(2) Particular attention to:

(a) _____

(b) type of _____

(c) tides and _____

(d) visibility

(e) _____

(f) _____

(g) obstacles or _____

2. Assistance and Emergencies

a. Emergency assistance in the event of an _____ or _____ _____

b. additional _____, _____, supplies or services

c. _____, authorization or _____ from higher authority

(1) should include _____, _____ time and a _____ to each of the following:

(a) _____ chamber

(b) _____ transportation

(h) _____ transportation

(d) Hospital

(e) Diving _____ Officer

(f) _____

(g) _____

(h) Diving Units

(i) Command

D. Establish Operational Task

1. A _____ _____ of the operation. Consider:

a. _____ and _____ dive activities and safety.

b. _____ time and _____ to the diving site.

c. _____ time

d. _____ and scope of _____ dives in a given period of time

e. Divers should have a _____ going from shallow to _____ depths.

f. Plan to work _____ and _____ while _____ permits, provided sufficient _____ are available.

g. Using different diving techniques requires different levels of _____.

h. The number of _____ working at any one time should be kept at a _____.

i. _____ personnel should be properly selected and _____

j. Any schedule must be _____ enough to allow for _____ _____.

k. Diving operation is completed when:

(1) _____, _____ and stowage of equipment is complete

(2) _____ of any materials brought up during the operation is complete.

(3) _____ of the divers and other _____ _____ has been accomplished.

(4) Analyze the _____ of the operation, as _____ and carried out.

(5) _____ and _____ of all required reports.

(6) _____ expended material.

(7) Insuring _____ of the unit to respond to the next _____.

E. Select Proper Diving Technique

1. Information from the _____ _____ and type of work should be considered.

a. If safety factors are against the use of SCUBA, _____ a _____ _____.

F. Select Equipment and Supplies

1. All equipment must be _____ _____

2. Requirements for Breathing Media

a. Conform to _____ of _____

b. _____ volume available

c. Flow to the _____ must be _____.

d. a _____ _____ must be available

3. Diving Support Craft

a. must be _____ in design and _____

b. must be equipped with _____ _____ and other _____ gear.

c. must be in good _____, with a _____ engine.

d. must have ample room for the divers to _____ and _____.

e. must provide adequate _____ and working area for the _____ crew.

f. must be able to safely carry all _____ required for the operation.

g. must be properly _____ by a _____ _____ crew.

4. For SCUBA Diving, an _____ _____ boat or _____ may be used.

G. Select and Assemble the Diving Team

1. The Diving Officer

a. is in charge of all _____ _____ and _____.

b. is responsible for the _____ and _____ _____ practices of all divers assigned.

c. is responsible for the preparation of _____ _____ for a diving operation, subject to final approval by the _____ _____.

d. insures a thorough _____ of all personnel involved.

e. his prime responsibility is the _____ _____ of all diving operations.

2. The Diving Supervisor - the man in charge of the diving operation.

a. may be an _____ or _____ . Selection is based on order of seniority.

(1) _____ Diver

(2) _____ _____ Diver

(3) _____ _____ _____ Technician

(4) _____ _____ Diver

b. must be a _____ diver

c. assists the Diving Officer in preparation for the _____.

d. he should be familar with the _____ to evaluate the diver's _____ and _____ _____.

e. inspects all _____ to be used

f. conducts pre-dive _____

g. monitors _____ and updates _____ to working divers

h. analyze the _____ and prepare _____ for higher headquarters

3. Diving Personnel

a. must be qualified for _____ being used and _____ of dive

b. must keep topside personnel advised as to _____ _____ and any developing _____ which may indicate needed change to

plans.

c. Using SCUBA, diver must keep track of _____ _____.

d. The diver is responsible for the _____ he will use and must insure it is in good _____ and _____ for use.

e. Standby diver must be ready to enter the _____ _____.

f. Buddy _____ must always be used when diving _____.

(1) Each diver keeps track of _____ and _____

(2) Divers are jointly _____ for the mission.

(3) Each should watch out for the _____ and _____ _____ of the other.

(a) _____ narcosis

(b) _____ sickness

(c) _____ _____ poisoning

(4) Keep buddy in _____ at all times.

4. Surface Crew

a. _____ works most closely with the diver.

(1) Checks diver before he enters the water.

(2) Constantly _____ the _____ to eliminate _____ or _____

(3) Uses line pull _____ for communication

(4) Keeps _____ informed of _____ and _____

(5) Remains alert for any signs of an _____

(6) Should be a _____ _____

(7) A _____ _____ must be briefed on the job prior to taking over the line.

b. Timekeeper

(1) Maintains _____ and fills out the _____ _____

(2) Usually operates the communication device, when applicable

(3) Notifies supervisor of _____ _____

(4) Must have a copy of the U.S.Navy _____ _____ _____

(5) Must be a _____ _____

(6) Must not be assigned _____ duties

(7) Should not keep time on more than _____ divers for accuracy.

(8) In SCUBA, the _____ often assumes the duties of the timekeeper.

c. Diving Medical Officer and Diving Medical Corpsmen

(1) Regularly assigned to provide _____ _____ and _____ to diving personnel.

(2) Instruct members of the diving team on emergency _____ _____ and _____ _____

(3) Medical Officer is mandatory for dives below _____ feet

(4) Certify _____ of divers

(5) Observe _____ of surface support personnel for _____, _____ and _____ _____.

H. Final Preparation and Check

1. Diving Officer and _____ must review plan

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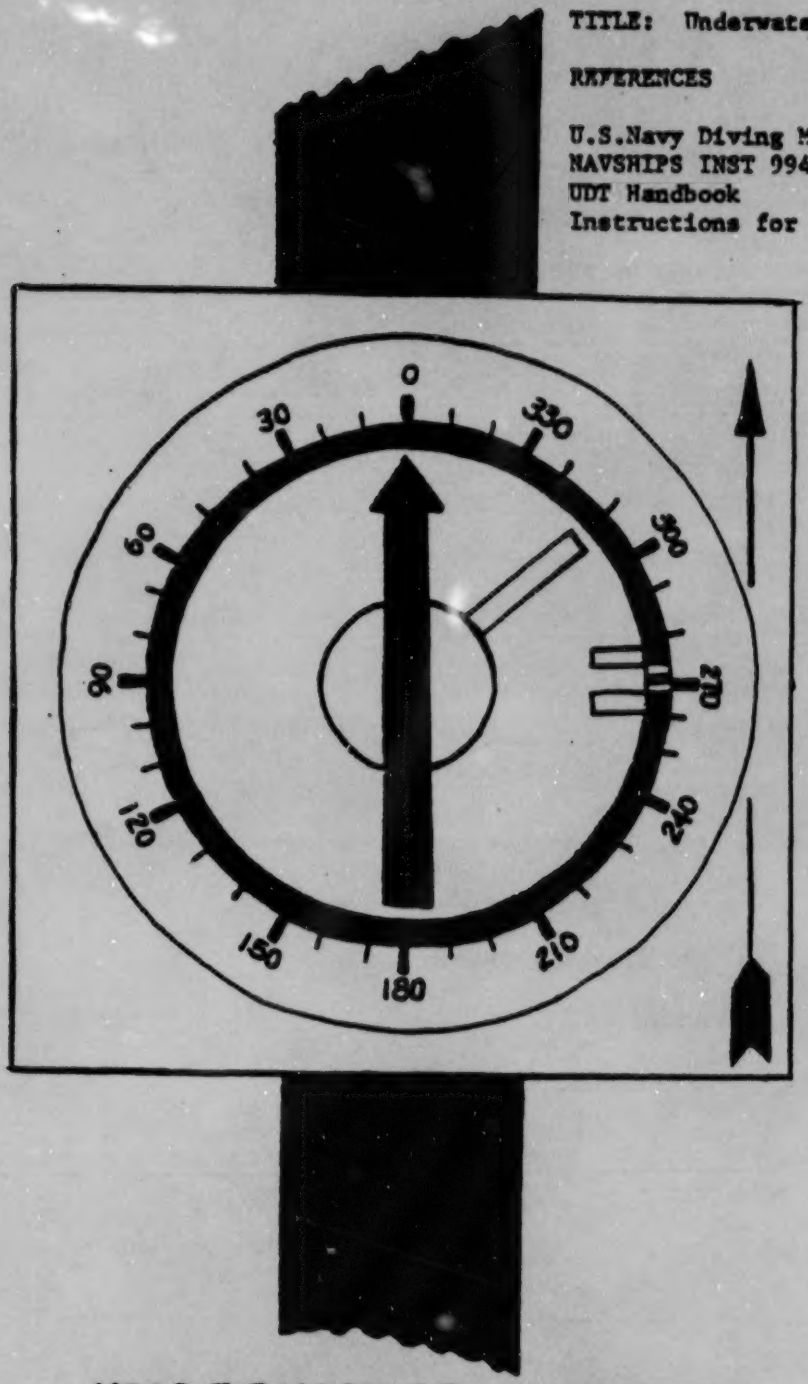
NOTETAKING SHEET 4-6-2N

NOTETAKING SHEET 4-6-1N

TITLE: Underwater Compass Swim

REFERENCES

U.S.Navy Diving Manual, Volume I
NAVSHIPS INST 9940.16A
UDT Handbook
Instructions for LS-1 Compass



UNDERWATER COMPASS

NOTETAKING SHEET 4-6-3N

NOTETAKING OUTLINE

A. Parts of a Compass

1. Lubbers Line

a. _____ fixed on the face of the compass

b. Aligns _____ and _____ _____.

2. Compass Card

a. Inside _____ _____ compartment

b. _____ points

c. North usually marked by an arrow

d. North arrow always points to _____ _____

e. Diver _____ under compass card

(1) Example:

f. Allow to _____ for a few seconds

3. Compass Bezel

a. Turntable -

b. Marked by:

c. Reference point shows _____ _____

4. Compass Case

a. Function:

b. Bearing Circle

(1) _____ increments - _____ total

(2) Reverse numbering system

c. Plastic or _____ material

492 NOTETAKING SHEET 4-6-4N

5. Wrist Strap

a. _____ or _____ material

b. one piece

c. _____ buckle

B. Use of the Underwater Compass

1. Worn on _____ or placed on _____ _____.

2. Line up _____ _____ with buoy

3. Line up _____ _____ on objective

a. Let compass card _____

4. Rotate Bezel, aligning _____ mark with _____

_____ (N - compass card)

5. Commence Swimming

a. Keep _____ _____ and body inline

b. Keep _____ _____ and north in line

c. Keep _____ level

6. Laying Out Course

a. Never _____ to the current

b. Cross current explanation:

c. Reciprocal (reverse) Course:

(1) Subtract _____ from original course

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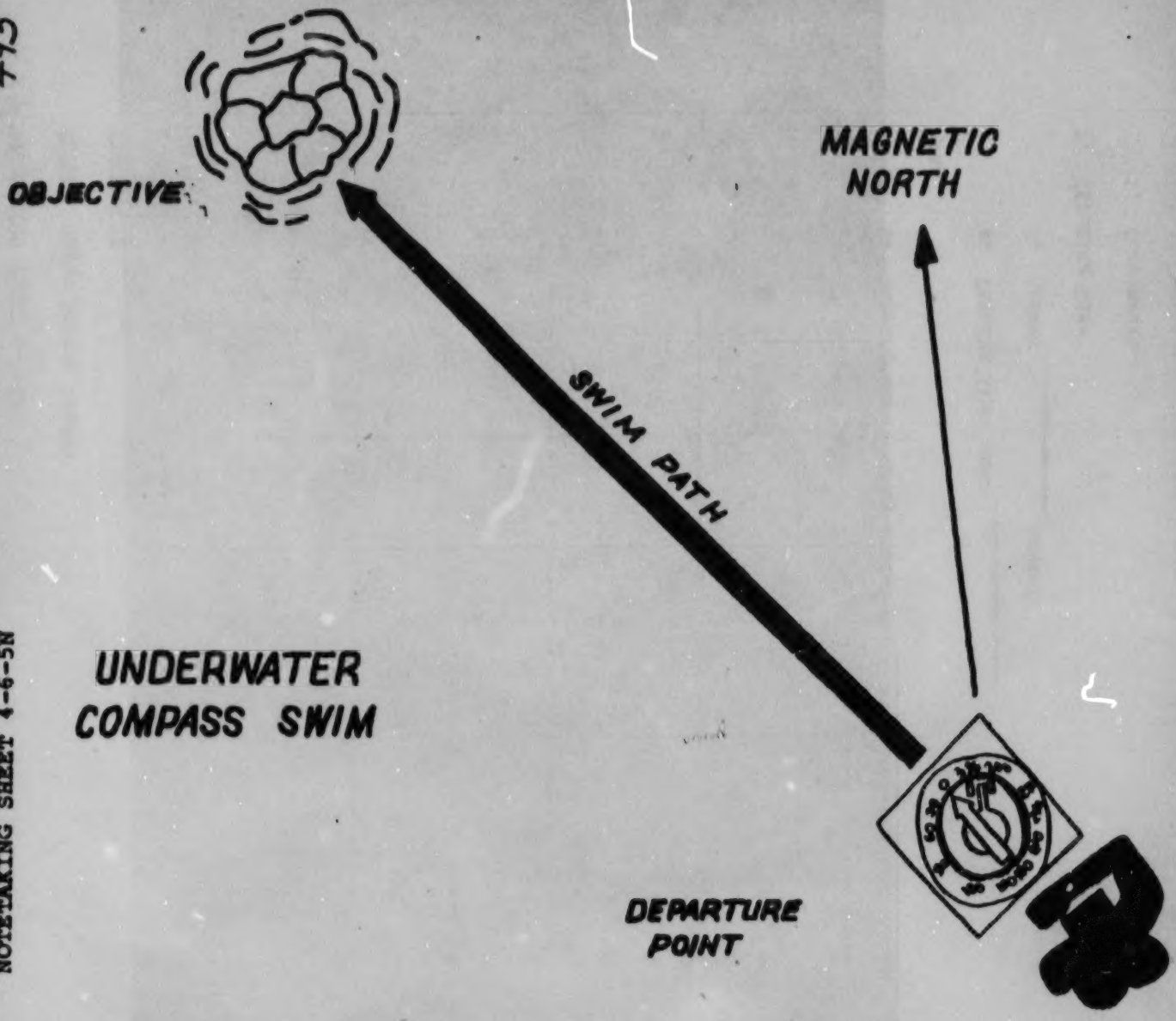


UNDERWATER COMPASS SWIM

NOTETAKING SHEET 4-6-5N

494 NOTETAKING SHEET 4-9-1N

TITLE: Night Bottom Search

REFERENCES

U.S.Navy Diving Manual, Volume I
NAVSHIPS INST. 9940-16A

NOTETAKING OUTLINE

A. Three Searching Methods

1. Tended Search - _____ to _____ areas

a. Restricted by _____ of _____ line

b. Restricted by placement of the _____ _____

2. Circling Line

a. _____ to _____ areas

b. tended or _____

3. Jack Stay

a. _____ to _____ areas

B. Tended Search

1. Surface _____ from a diving _____

a. use standard U.S.Navy Diving _____ _____

b. Tending line - long enough to _____ _____ area

c. Tending line kept _____

d. Answer _____ signals

C. Circling Line

1. Components

a. Buoy:

b. Buoy Line:

c. Clump:

d. Circling Line or _____ _____

(1) _____ long

(2) Knotted every _____ feet

(3) Must _____ freely on _____ _____

e. 360° Marker Buoy:

2. Method 1

a. diver descents on _____ _____

b. locates _____ _____

c. diver searches _____ sweep on _____ knot

d. diver moves to _____ knot

(1) searches _____ sweep

e. continue until _____ is _____

3. Method 2

a. diver descends on buoy line

b. locates swim line

c. swims to _____ knot

d. commence _____ sweep

(1) searching and dragging swim line low, attempting to _____ _____

e. Move in (toward buoy line) _____ knot after each _____ sweep until the _____ is found

4. Method 3 - for _____ _____ only

a. one diver swims at _____ _____

b. one diver swims at _____ _____

c. both divers make _____ _____

D. Jack Stay Search

1. Components

a. 2 Buoys:

b. 2 Buoy Lines:

c. 2 Clumps:

d. Jackstay or Search Line

(1) long enough for _____ _____

(2) _____ conditions, _____ influende length

2. Method 1 - Rectangular Search

a. diver descands on buoy _____

b. searches along _____ _____ to buoy _____

c. moves buoy _____ in direction of _____

d. search back to buoy _____

e. move buoy _____ in direction of search

f. continue until _____ is _____

g. distance buoy is moved is influenced by:

(1) _____ _____

(2) _____

3. Method 2 - Circular Search

a. _____ _____ is stationary

b. _____ _____ is mobile

c. diver desends on _____ _____

d. searches out on Jack stay line to _____ _____

NOTETAKING SHEET 4-9-4N

e. move _____ _____ in direction of search

f. search back to _____ _____

g. search back to _____ _____

h. move _____ _____ in direction of search

i. continue until object is found or _____ _____ is made.

498 NOTETAKING SHEET 4-10-1N

TITLE: Underwater Hull Inspection

REFERENCES

U.S.Navy Diving Manual, Volume I
Underwater Work Techniques Manual, Volume I

NOTETAKING OUTLINE

A. Hull Inspection

1. Complete examination of _____ _____.

   a. _____ _____ of hull.

   b. _____ _____to hull.

2. Ships hulls have _____ configuations.

   a. Basic hull inspection techniques are _____ _____.

3. Normally involve many _____.

4. May include _____ underwater _____ survey.

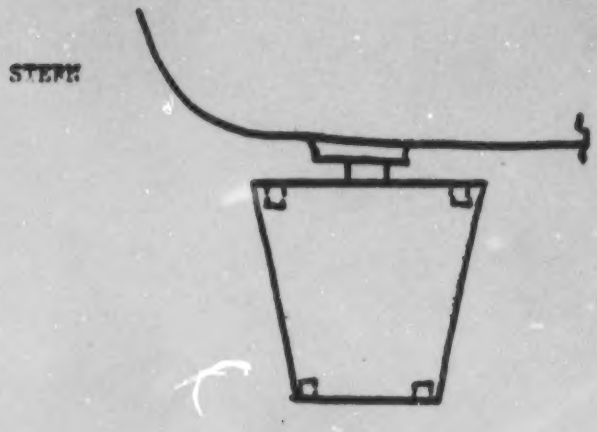
5. Always review _____ hull inspection report.

6. Use _____ _____ _____ _____.

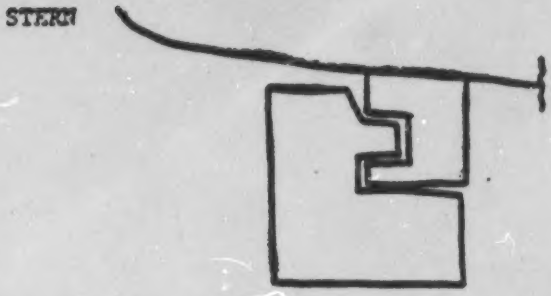
   a. locate _____ _____ in close proximity to work.

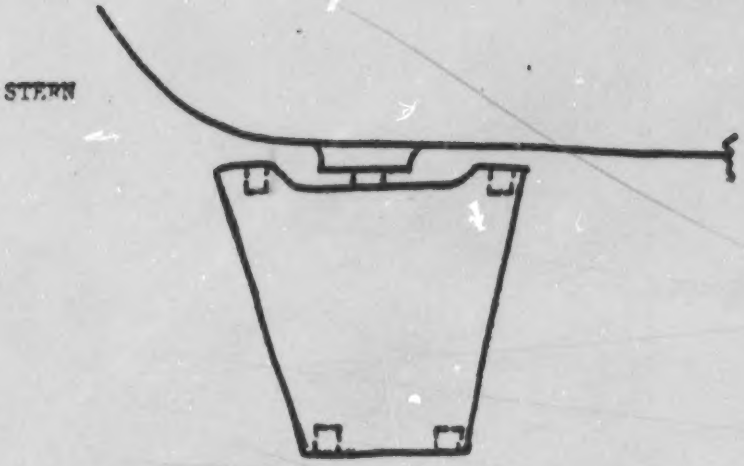
   b. take _____ current into consideration as to _____ location and _____ point.

7. _____ _____ are a must.



UNSTEPPED RUDDER



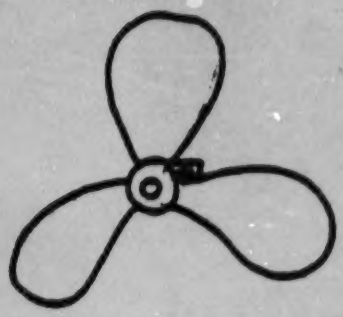


STEPPED RUDDER

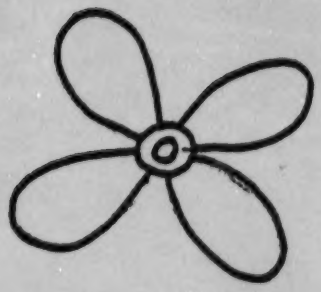
EXAMPLES OF RUDDER CLEARANCES

500 NOTETAKING SHEET 4-10-3N

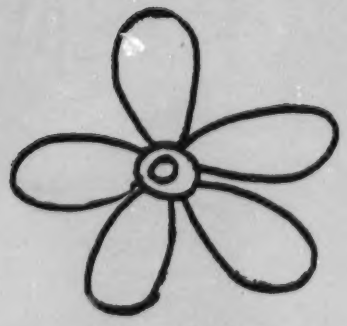
TYPICAL PROPELLOR - STRUT ASSEMBLY



THREE BLADED PROPELLOR

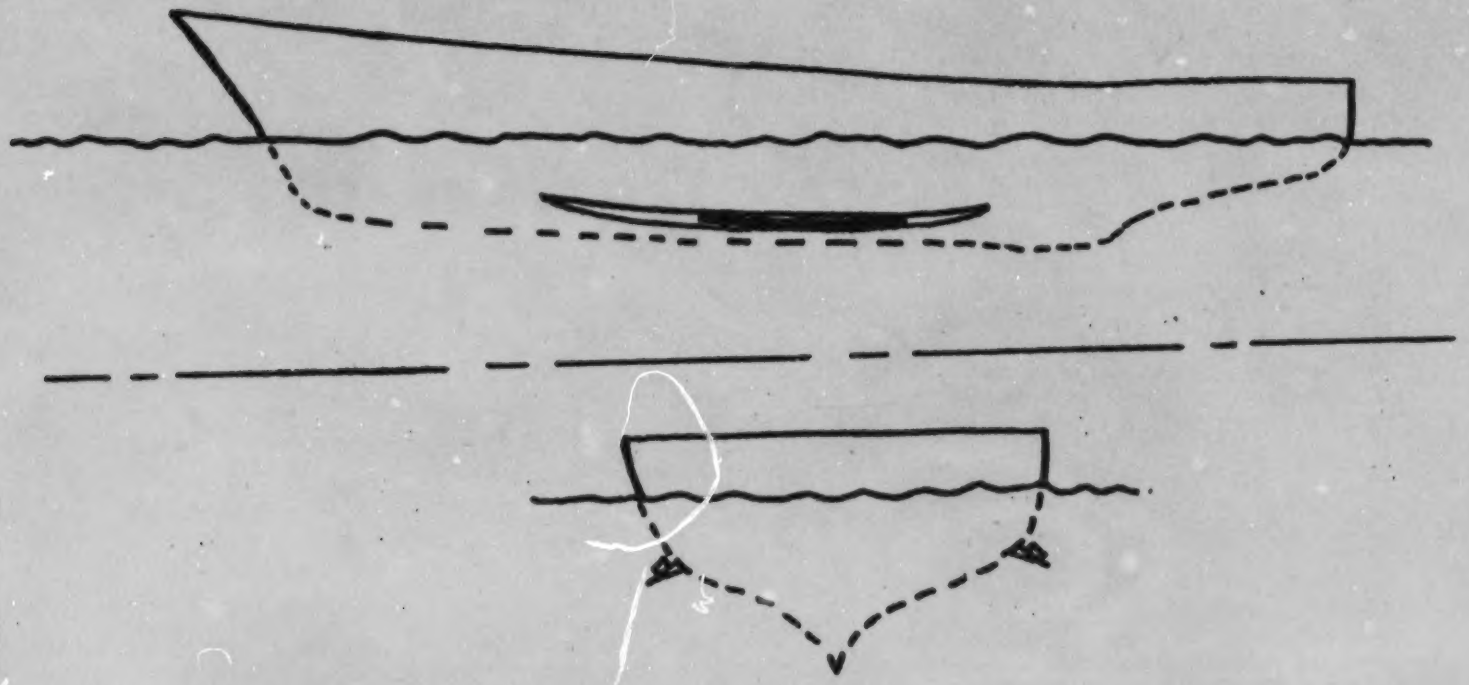


FOUR BLADED PROPELLOR



FIVE BLADED PROPELLOR

EXAMPLES - BLADE NUMBERING



TYPICAL BILGE KEEL LOCATION

502 NOTETAKING SHEET 4-10-5N

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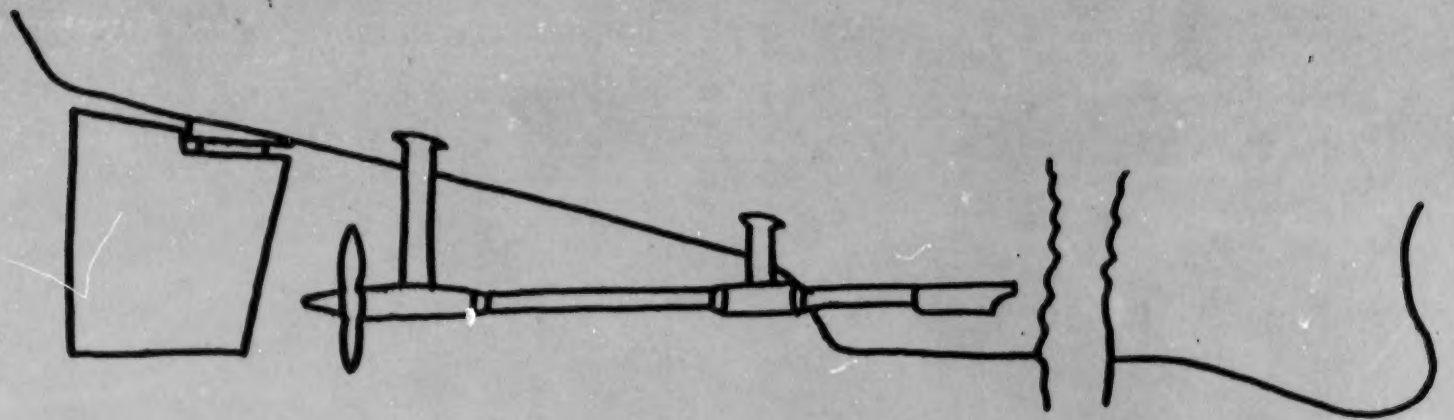
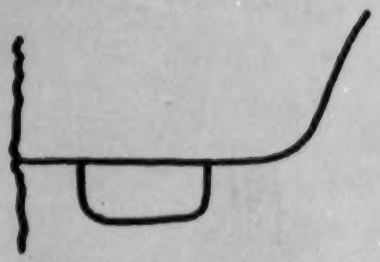


HULL CONFIGURED
SONAR



KEEL MOUNTED SONAR

NOTETAKING SHEET 4-10-6M

TYPICAL DLG AND DLGN TYPES U/W HULL
OUTBOARD PROFILE

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504 NOTETAKING SHEET 4-11-1N

TITLE: General Safety Precautions

REFERENCES

U.S.Navy Diving Manual, Volume I
Diving and Salvage Safety Notes 1971/72

NOTETAKING OUTLINE

A. Diving on Ships in a Nest

1. Ship _____ _____ Checklist

a. filled out, _____, and adhered to

b. _____ ships will be tagged out

2. Code Alfa Flag

a. displayed by _____ _____ _____ _____.

b. displayed by _____ _____

c. as necessary

3. Camels

a. description:

b. must be _____ ships

4. Berthing or Shifting Berthing

a. _____ ships will shift berth or _____ _____ _____ during diving operations

5. Access to Surface

a. maintain _____ access to surface

b. use _____ _____ or descent _____

6. Diving Platform - as _____ as possible to _____ area.

NOTETAKING SHEET 4-11-2N

7. Diving Supervisor

a. must brief _____ and ships personnal on _____

_____

b. communications must be maintained with _____ _____

_____

B. Diving Using Explosives

1. Supervisor must have _____ _____

a. Accomplished by retaining:

(1) _____ key

(2) _____ fuse

2. 300 psi shock wave or greater

a. will damage _____

b. will damage _____

c. 300 psi shock = _____ charge, _____ feet from diver

3. Anticipation of Underwater Explosion

a. leave water if possible

b. if impossible, float _____ _____

c. keep _____, _____ and _____ _____

up and out of water

C. Diving on Submarines

1. Nuclear Submarines - _____ hazard

a. contact _____ Officer, plan dive

b. wear _____ _____ badge

2. All Submarines

a. Use Ship _____ _____ Checklist

506 NOTETAKING SHEET 4-11-3N

D. Propellor Change

1. _____ moor is highly desireable

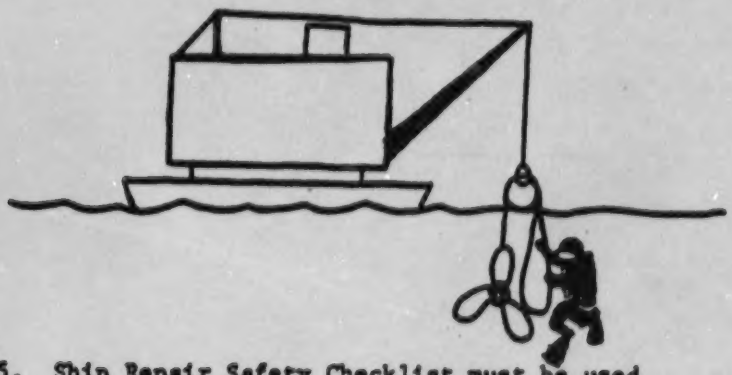
2. secure _____ _____ adequately

3. _____ team and _____ operator must be thoroughly briefed

4. Chain Fall Method

a. _____ controls chain fall

b. _____ stowed in oil bath.



5. Ship Repair Safety Checklist must be used

E. Heavy Currents

1. _____ _____ - maximum SCUBA operations

2. Use a _____ _____.

3. Have safety _____ available

4. Divers must be in top _____ _____

5. Stay clear of _____ _____

6. Schedule work for _____ _____

7. Rip Tide

a. Ride it out - don't fight it

8. Approach a job sight from _____ _____.

F. Open Sea Diving Operations

1. Gather all available _____

a. _____ charts, _____, _____

conditions

2. monitor _____ reports

3. _____ _____ with base

4. _____ boat

5. Minimum - _____ _____ moor

6. First divers down check _____

7. Divers must be in top _____ _____

8. Emergency _____ for _____

a. Emergency _____ - U.S.Navy Diving Manual, page _____

G. Cold Water Diving Operations

1. _____ _____ Condition

2. Use proper _____, gear

a. U.S. Navy Diving Manual, page _____, Figure _____

3. Short _____ _____

a. Accustom divers to cold water _____

4. Respiration Rate _____ than normal

a. increased danger of _____ _____

5. Water Entry - enter _____

a. increased danger of _____ _____

b. can lead to _____

508 NOTETAKING SHEET 4-11-5N

6. Do not neglect _____ personnel

H. Diving Polluted Waters

1. Sources

a. _____ discharges

b. _____ discharges - chemicals/high _____

2. Use _____ clothing

3. Guard against _____ of water

4. Appropriate _____ medical procedures

a. _____ _____ up to date

5. Increased vulnerability to:

a. _____ and _____ infections

6. Extreme Warm Water Operations

a. be alert for _____ _____

I. Closed Spaces

1. SCUBA is _____ used to enter a _____ _____

2. All closed spaces must be:

a. _____ before entering

b. _____ circulated

c. inspected for _____ _____

(1) _____ _____ Gas

(2) Produced by _____ _____ material

NOTETAKING SHEET 4-11-6N

(3) DEADLY

(a) Explosive

(b) _____

(c) Small amounts: _____ _____ odor

(d) Large amounts: _____ _____

(e) _____

U.S. GOVERNMENT PRINTING OFFICE: 1977 240-634/187 1-1

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FOR OFFICIAL USE ONLY

STUDENT GUIDE

FOR

DIVER, SECOND CLASS (A-433-0022)

MEDICAL DEEP SEA DIVING TECHNICIAN (A-433-0020)

SHIP SALVAGE DIVING OFFICER (A-4N-0011)

DEEP SEA (HeO2) DIVING OFFICER (A-4N-0010)

VOLUME G

Underwater Advanced

PREPARED BY

NAVAL SCHOOL DIVING AND SALVAGE

PREPARED FOR

SERVSCOLCOM, SDIEGO

SUBTRACENPAC, PHARBOR

NAVSCOLDIVSAL, WASH

31 OCTOBER 1975

511

ASSIGNMENT SHEET 7-1-1A

TITLE: Surface Supplied Diving Operations Pre-Dive Checklist (Underwater Advanced)

LESSON TOPIC OBJECTIVES

Terminal Objectives

1. When the student completes this course he will be able to, as a member of a four man team, complete the applicable items of the Surface Supplied Diving Operations Pre-Dive Checklist to prepare the Mk V Deep Sea Diving System for daily use and secure the gear upon completion of the daily diving activities.

Enabling Objectives

1. Orally explain the use of the Surface Supplied Diving Operations Pre-Dive Checklist.
2. Demonstrate the correct procedures for completing the items necessary for preparation of the Mk V Deep Sea Diving System for daily use.
3. Using a standard print (illustration) of the school's diver's breathing air system:

    a. Label the print with correct symbols to show all major components.
    b. For the major components:
        (1) Explain, in writing, their function.
        (2) List, in writing, the protective devices within the system.
        (3) Describe, in writing, the protection provided by the devices.
        (4) List, in writing, the ratings of applicable major components and material used in their construction.
4. Orally describe the maximum standards for breathing air and the reasons for the standards.
5. Orally state the setpoint(s) for cleaning, test and calibration of gages.
6. State, in writing, the safety precautions necessary to insure air purity.
7. Demonstrate the correct procedures for completion of items necessary to secure the Mk V Deep Sea Diving System from daily diving activities.

STUDY ASSIGNMENT

U.S.Navy Diving Manual, Volume I, Paragraph 6.2

ASSIGNMENT SHEET 7-1-2

STUDY QUESTIONS

1. What must diver's breathing air meet, regardless of source?

   a.
   b.
   c.
   d.

2. Who is responsible to determine the adequacy of the air system for a specific dive?

3. Why must care be taken in the placement of diving air compressors?

4. What is the primary requirment of an air supply system used with open-circuit equipment?

5. Define "Mixing Effectiveness Factor".

6. What is the maximum overbottom pressure requirment for a dive of 145 feet?

7. What two ways could be used to control the amount of water vapor in the diver's breathing air?

   a.

   b.

9. List the three basic types of air supply systems.

   a.

   b.

   c.

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ASSIGNMENT SHEET 7-1-3A

9. Complete the following:

a. All _____ and _____ which directly influence the air supply _____ _____ _____ with the warning "DIVER'S AIR SUPPLY - DO NOT TOUCH". All personnel, both diving and non-diving, who may be in the vicinity of such _____ or _____ during an operation must be _____ not to _____ any _____ so marked.

b. A _____ _____ or _____ must be part of the air supply system and be located _____ the supply source and the diver's _____ _____. This tank serves to maintain an immediate, available _____ _____ _____ should the primary supply source _____.

10. What are the disadvantages of:

a. Centrifugal Compressor:

b. Rotary Compressors

11. Why will the actual capacity of a compressor always be less than the ideal capacity?

12. Why is the type of lubricant used in air supply systems important?

13. Describe intercoolers and their function.

ASSIGNMENT SHEET 7-1-4A

14. Why is it important that the compressor always work against a back pressure?

a.

b.

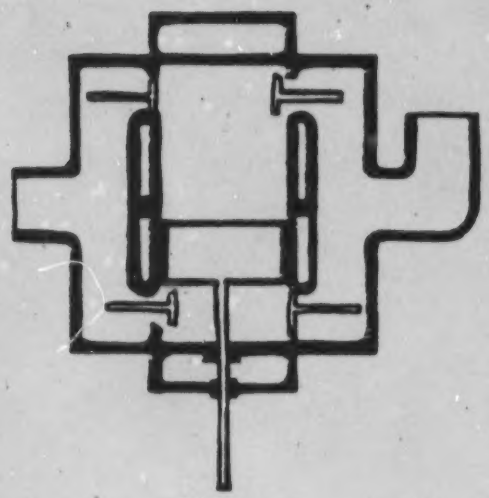
c.

15. How many high pressure air cylinders are needed for a satisfactory air supply system? At what rating?

16. What actions are to be taken when pressure in a high pressure air cylinder air supply system reaches 220 psi above the diver's working pressure?

17. What is an accumulator?

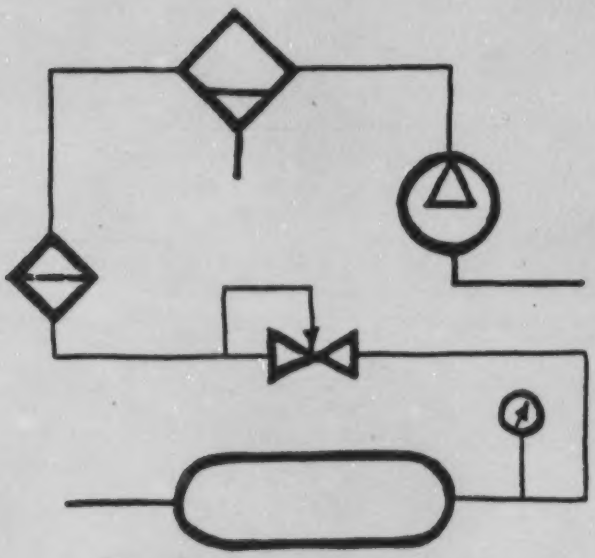
ASSIGNMENT SHEET 7-1-5A



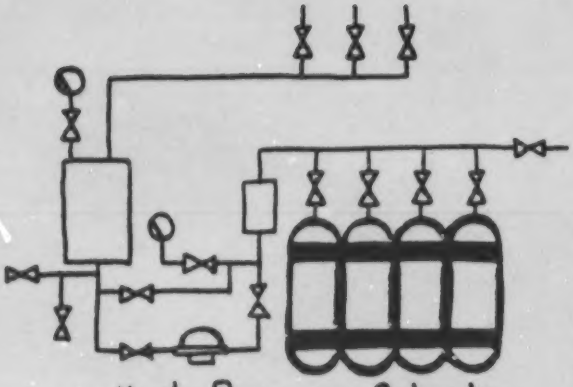
Typical Double Acting Piston Compressor

PISTON COMPRESSOR - Label the components and trace the air flow through the system.

COMPRESSOR/AIR CYLINDER BANK AIR SYSTEMS - Label the components.



Compressor-Equipped Air Supply System



High Pressure Cylinder Bank Air Supply System

ASSIGNMENT SHEET 7-2-1A
TITLE: Mk V Deep Sea System Diver (Underwater Advanced)

LESSON TOPIC OBJECTIVES

Terminal Objectives
1. When the student completes this course he will be able to, as a diver, using a Mk V Deep Sea Diving System in open water at a depth of at least twenty feet, demonstrate increased proficiency in the use of the Mk V Deep Sea Diving System by successfully completing, in accordance with Diving Training Standards, any three of the following projects: Angle Descent, Tunneling, Hogging Line, and Two-Man Pontoon.

Enabling Objectives
1. Given a job analysis sheet on each project to be accomplished during this unit, orally explain the following aspects of the project:

a. What the project is.
b. The conditions under which the project is to be completed.
c. Standards which will determine success.
d. How to perform the project successfully.
e. How each project relates to a fleet diving job.
f. Particular skills necessary for successful completion of the project.

STUDY ASSIGNMENT

Review U.S.Navy Diving Manual, Volume 1, Chapters 6 and 8 (paragraphs pertaining to diver activites)

STUDY QUESTIONS

None

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JOB SHEET 7-2-1J

TITLE: Mk V Deep Sea Diving System Diver (Underwater Advanced) Hogging Line, Tunneling, Angle Descent, and Two-Man Pontoon Projects

INTRODUCTION

This will be the final unit devoted to teaching you to use the Mk V Deep Sea Diving System. There will be units in your training when you will be using the Mk V System, but, at those times, you will be concentrating on other phases of your training. The projects in this unit require knowledge of the diving system and the ability to use it (i.e. buoyance control, etc.) as well as mechanical ability and teamwork.

As before, work quickly and thoroughly. Plan your working dive in your mind before you ever leave the surface so that when you arrive on the job site, you can begin work immediately, knowing what to do and how to do it. In order to successfully complete this unit, you must complete three of the four projects within the Satisfactory limits of Diving Training Standards.

REFERENCES

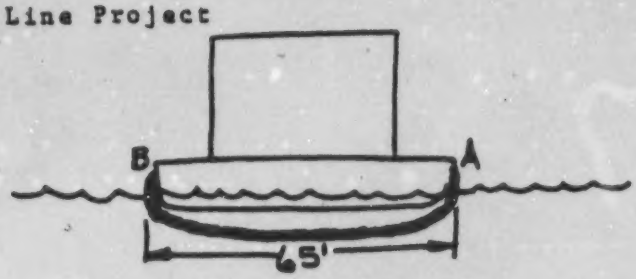
Diving Training Standards

EQUIPMENT AND MATERIAL

Diving Underwear, Diving Socks, Tool Bag, Mk V Deep Sea Diving System, Material for Hogging Line, Tunneling, Angle Descent, and Two-Man Pontoon Projects.

JOB SHEET 7-2-2J

1. Hogging Line Project



a. Diver enters the water via ladder.

b. Adjust buoyancy (determined by diver) to near neutral.

c. Swim to the hogging line.

d. Beginning at Point A (on drawing above), proceed along hogging line hand-over-hand until you reach Point B.

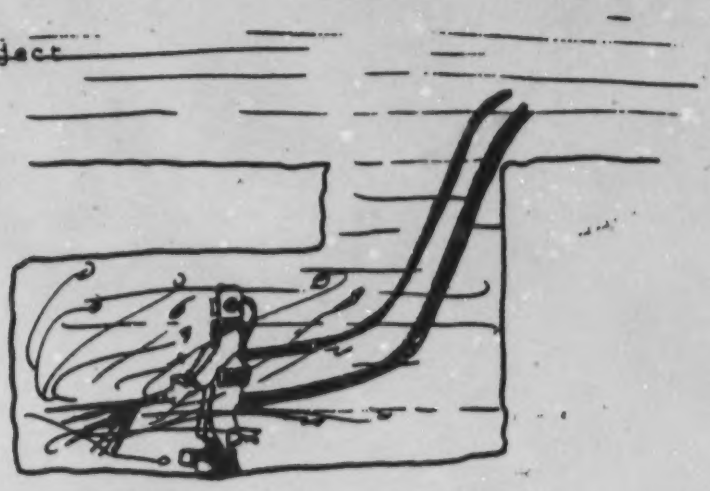
e. Clear surface with helmet enough to make eye contact with instructor at Point B.

f. Return, in the same fashion, to Point A.

g. Swim to the ladder and come up.

519 JOB SHEET 7-2-3J

2. Tunneling Project



a. Diver uses proper line-pull signals/voice communications and descends to the bottom (at least twenty feet) via ladder and descent line. Hose nozzle will be attached to first diver of the day.

b. Tenders will put the diver on Searching line-pull signals. Diver, at direction of tenders, backs away from diving platform to an area twenty to thirty feet away.

c. Tenders take diver off searching signals.

d. Diver faces away from the diving platform, straddle hose and insert wrists into the loops secured to the nozzle.

e. Diver request water pressure to the hose and begins rotating the nozzle in a circular motion.

f. When diver completes the hole and tunnel, request topside to secure the water pressure.

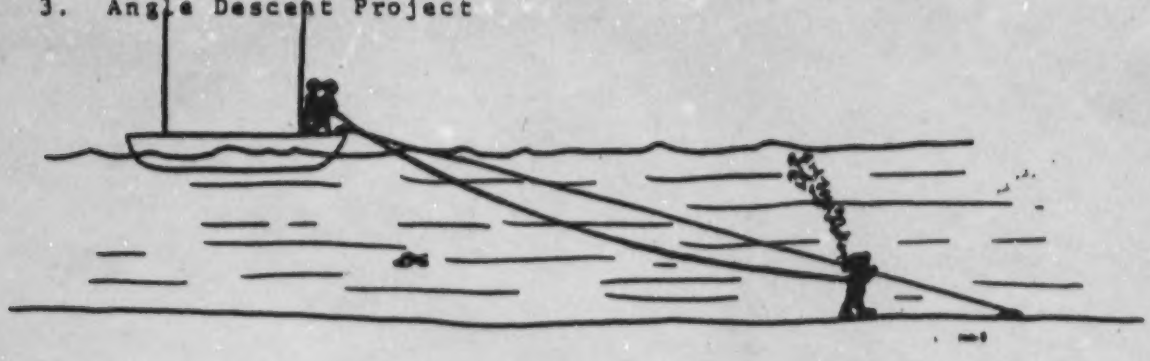
g. Diver buries nozzle in the bottom of the river/channel.

h. Diver uses proper line-pull signals/voice communications and returns to the surface.

i. Subsequent divers may use the water hose as a descent line.

JOB SHEET 7-2-4J

3. Angle Descent Project



a. Diver enters the water via ladder. Receive the bitter end of shackle pennant. Make yourself slightly positively buoyant and swim to descent line.

b. Readjust buoyancy and descend on line until you reach the bottom.

c. Back out on descent line until you reach the clump.

d. When on the clump, spread feet apart, facing diving platform and plant feet firmly (make yourself slightly heavy by adjusting Air Control Valve).

e. Pull in shackle pennant until shackle is received, laying all line received between feet.

f. Do not move feet. Tenders will feed shackle on retreiving line.

g. When the shackle is received, diver will remove the pin from the shackle and secure the shackle on retrieving line.

h. Give proper line-pull signals for tenders to retrieve shackle.

i. At word that the shackle is on the surface, diver will give proper line-pull signals and come to the surface.

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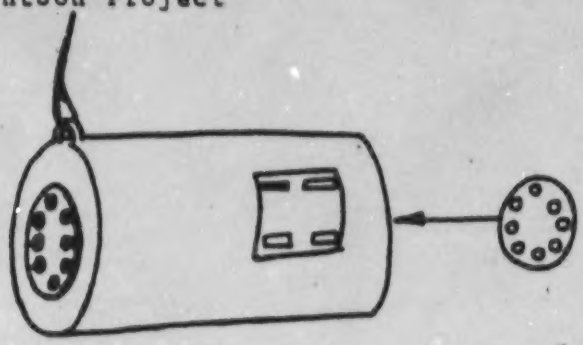
JOB SHEET 7-2-5J

4. Two-Man Pontoon Project



a. Project is placed on the bottom on project whip.

b. Two divers use proper line-pull signals/voice communications and descend to bottom via ladder and project whip.

c. Diver #1 removes "J" bolt patch, requests square mark and sends the patch topside.

d. Diver #2 removes the large end patch and sends gasket topside on a square mark.

e. Diver #1 begins removing small end patch by reaching through "J" patch access.

f. Diver #2 enters the pontoon through the large end opening and helps remove the small inside patch.

g. Once the patch is removed, Diver #2 removes gasket and gives it to Diver #1 (outside) who, in turn, sends it topside via square mark.

h. Instructor will immediately return <u>all</u> gaskets to Diver #1.

i. Small end gasket is given to Diver #2 (inside) for replacement.

j. Diver #1 begins replacing "J" bolt patch.

k. Diver #2 exits the pontoon and begins replacing the large end patch.

l. When all patches are in place and tight, Diver #1 sends for an air hose and connects it to the air hose fitting on the pontoon.

m. Both divers, in turn, give proper line-pull signals/voice communications and return to the surface.

ASSIGNMENT SHEET 7-3-1A
TITLE: Mk V Deep Sea Diving System Tender (Underwater Advanced)

LESSON TOPIC OBJECTIVES

Terminal Objectives
1. When the student completes this course he will be able to, as a member of a team tending a diver using Mk V Deep Sea Diving System in open water:

a. Use correct line-pull and telephone communications procedures throughout all training dives.

b. Dress a diver in a Mk V Deep Sea Diving System, within twelve minutes, so that he may safely enter the water.

c. Demonstrate proper maintenance of the Diving Log and OPNAV Form 9940/1.

Enabling Objectives
The skills above are a continuation of skills and knowledge developed during previous units.

STUDY ASSIGNMENT

Review U.S.Navy Diving Manual, Volume I, Chapter 6 (paragraphs, tables, appendixes concerning tending)
Diving Training Standards for Communications

STUDY QUESTIONS

None

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NOTETAKING SHEET 7-1-1N

TITLE: Surface Supplied Diving Operations Pre-Dive Checklist (Underwater Advanced)

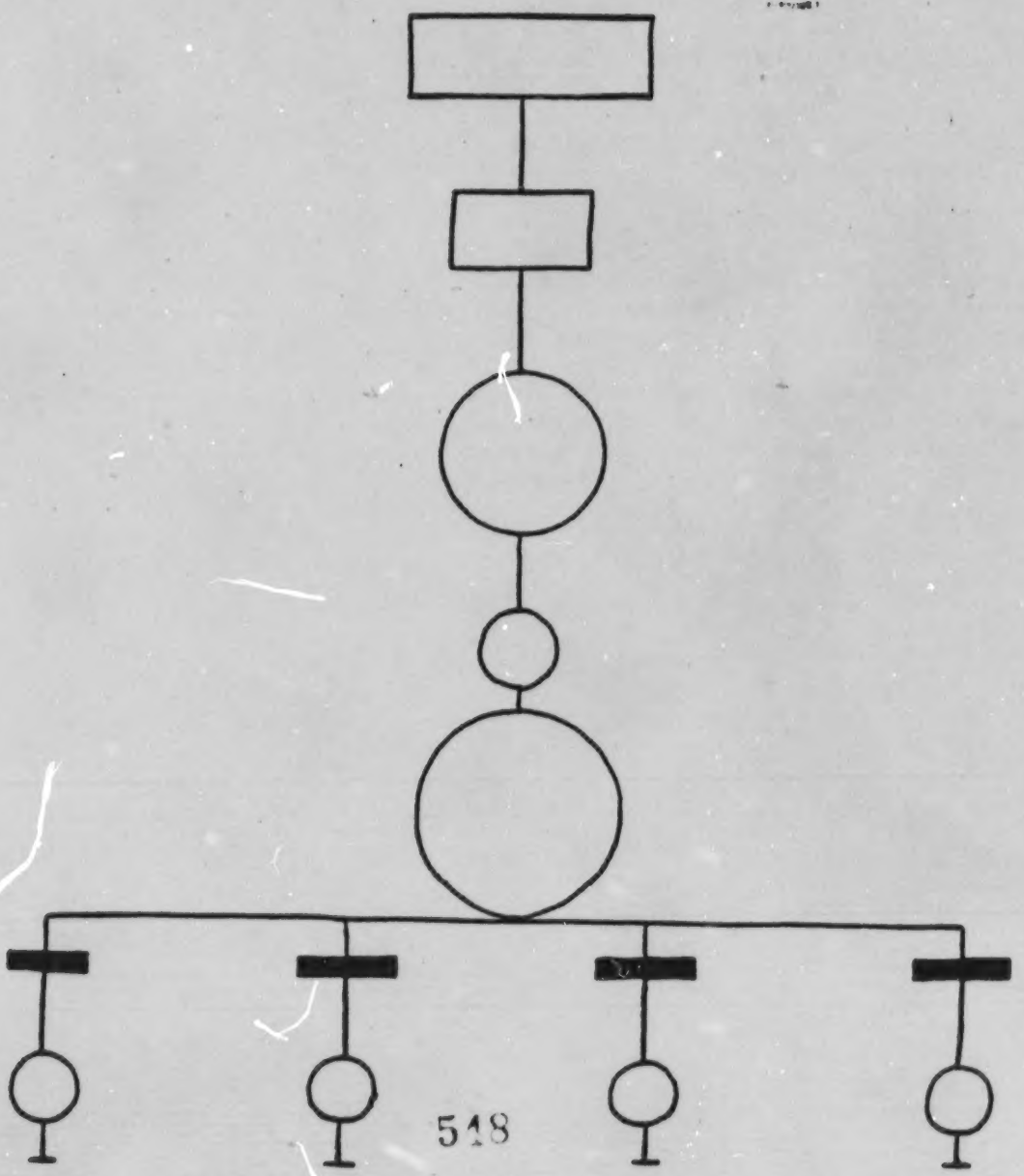
REFERENCES

U.S.Navy Diving Manual, Volume I

NOTETAKING OUTLINE

A. Diver's Breathing Air System

1. School's System (for diving bays)



NOTETAKING SHEET 7-1-2N

2. High Pressure Air Compressors

   a. 2 available

   b. Made by _____ Pneumatic

   c. Used to maintain _____ _____ in _____ _____ _____.

   d. Rated _____ psi

   e. Not a _____ _____ compressor

   f. _____ driven

   g. _____ stages

   h. Located in the Compressor Room

   i. High pressure alarm goes off at _____ psi.

   j. _____ _____ lifts at 3300 psi.

3. High Pressure Air Flasks

   a. _____ banks

   b. _____ flasks per bank

   c. Each flask has a valve for _____ _____.

   d. Hydrostatically Tested at _____ psi.

   e. _____ _____ have Relief Valves.

4. Low Pressure Air Compressors

   a. Not in use in school's air system.

   b. On board YDT 14 and 15 with _____ _____.

      (1) _____ psi

      (2) Manufacturer, I&R

   c. Usually portable or _____ compressor.

   d. _____ _____ compressor.

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NOTETAKING SHEET 7-1-3N

5. Low Pressure Volume Tank

a. Used with _____ _____ _____.

b. Used with _____ High Pressure Air.

6. High Pressure Piping

a. Usually High Pressure _____ _____ _____ tubing.

(1) _____ wall thickness

b. _____ _____ normally used

(1) High Pressure _____ valve.

c. _____ psi working pressure.

d. Relief Valve installed for 3300 psi.

e. Tested at _____ psi.

f. Used from _____ _____ compressor to High Pressure _____ to _____.

7. Low Pressure Piping

a. Carries normal _____ _____ pressure.

b. _____, _____ or _____ tubing.

c. _____ psi normal pressure.

d. Tested to _____ times working pressure.

e. Relief valve lifts at _____ over working pressure.

8. Filters

a. Function - eliminate _____, _____, etc. from air.

b. Two types

(1) Between Compressor and Banks/Volume Tanks

(a) _____, _____

(b) _____ element

NOTETAKING SHEET 7-1-4N

9. Pressure Reducers

a. Normally _____ type

b. Manufactured by Grove Co.

c. Function - _____ high pressure air to desired _____ _____.

(1) Can be set at:

10. Hand Loader

a. Manufactured by Grove Co.

b. Direct _____ of _____ _____

c. Used with mixed gas diving to maintain over-bottom pressure during ascent and descent.

11. Other Accessories

a. Moisture

(1) _____ moisture from system after _____ _____.

b. Relief Valves

(1) Relieves pressure from system when it _____ _____ _____ _____.

(2) Set at 10% over working pressures.

c. Gauges

(1) Installed in system for _____ _____ readings

NOTETAKING SHEET 7-1-5N

(2) Calibrated according to _____ requirements

d. Crow's Foot

(1) For diving _____ _____ _____ _____.

(Maximum, _____)

e. "T" Fitting

(1) _____ thread on one end, _____ threads on the other.

(2) Double _____

f. "S"

(1) Double _____

(2) _____ pipe thread on one end, _____ thread on the other.

g. Double Male

(1) Diver's thread

h. Double Female

(1) Diver's thread

i. Oil Separator

(1) Removes oil from system after compressor.

j. Heaters and Coolers

(1) Used to _____ _____ _____.

(2) _____ or _____ used.

(3) _____ type.

B. Diver's Breathing Air Standards

1. Must conform to the following:

a. Oxygen - _____-_____% by volume

NOTETAKING SHEET 7-1-6N

b. Carbon Dioxide - _____-_____ parts per million;

_____-_____% by volume.

c. Carbon Monoxide - _____ parts per million maximum;

_____% by volume.

d. Oil, Mist and Vapor - _____ milligrams per cubic millimeter maximum.

e. Solid and Liquid Particles - not _____ except as noted above under Oil, Mist and Vapor.

f. Odor - not _____

2. Insure quality by:

a. Using only U.S.Navy _____ _____ compressors.

b. Use only approved _____.

c. Have air _____ regularily.

d. Insure _____ is drained from _____ periodically while running.

e. Air stored in flasks will be drained and _____ annually.

f. NEVER PUT A DIVER IN THE WATER IF THE _____ _____ _____ _____.

FOR OFFICIAL USE ONLY

STUDENT GUIDE

FOR

DIVER, SECOND CLASS (A-433-0022)

MEDICAL DEEP SEA DIVING TECHNICIAN (A-433-0020)

SHIP SALVAGE DIVING OFFICER (A-4N-0011)

DEEP SEA ($He0_2$) DIVING OFFICER (A-4N-0010)

VOLUME H

Light Weight Diving

Systems

PREPARED BY

NAVAL SCHOOL DIVING AND SALVAGE

PREPARED FOR

SERVSCOLCOM, SDIEGO

SUBTRACENPAC, PHARBOR

NAVSCOLDIVSAL, WASH

31 OCTOBER 1975

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ASSIGNMENT SHEET 8-1-1A

TITLE: Lightweight Diving System Diver

LESSON TOPIC OBJECTIVES

Terminal Objectives

1. When the student completes this course he will be able to as a diver, perform the following functions:
   a. In an open tank, with a minimum of eight feet of water, using the Lightweight Diving System (Jack Browne), demonstrate ditching and donning procedures.
   b. In an open tank, with a minimum of eight feet of water, using the Mark I Mask, demonstrate emergency air change-over procedures.
   c. In open water, at a minimum depth of twenty feet, using Mk I Mask and Hot Water Suit, complete the Searching Project in accordance with Diving Training Standards.

Enabling Objectives

1. Orally, explain the correct procedures for dressing a diver using the Lightweight Diving System (Jack Browne).
2. Orally describe the prevailing conditions which would prompt a diver using the Lightweight Diving System to use the procedures of ditching and donning.
3. Demonstrate correct procedures for ditching, clearing the mask, and donning for continued work, the Lightweight Diving System.
4. Orally explain the procedures for dressing a diver using the Mark I Mask.
5. Describe, orally, the prevailing conditions (including indications received by the diver) which would prompt a diver using the Mark I Mask to use the procedures for emergency air change-over.
6. Demonstrate correct procedures for emergency air change-over, using the Mark I Mask.
7. Orally explain the correct procedures for dressing a diver in a Hot Water Suit.
8. Demonstrate correct procedures for dressing a diver in a Hot Water Suit.
9. Explain, orally, the Searching Project, in accordance with Diving Training Standards, to include standards, how to perform the project, and particular skills needed for the successful completion of the project.

STUDY ASSIGNMENT:

Reading Assignments for theis Lesson Topic will be included in Study Assignments for 8-2 and 8-3.

STUDY QUESTIONS

NONE

JOB SHEET 8-1-1J

TITLE: Lightweight Diving System Diver--Ditching and Donning Procedures

INTRODUCTION

This will be your first diving experience in the Jack Browne Diving Mask and it is important that you learn emergency procedures immediately. These ditching and donning procedures are very similar to those practiced in SCUBA so think back to your experience there. An important thing to remember during this dive as well as the next dive, your first with the KMB-9 Mask, is NOT TO PANIC. The procedures to deal with emergencies are available and these practical dives are designed specifically to teach those emergency procedures to you and give you the opportunity to practice them. But many diving students panic the first time their mask is flooded or their primary air supply is secured because they are convinced they cannot get the mask cleared or emergency air turned on before they have to breathe. Without the feeling of panic, and individual can hold his breath for at least one minute. Responding correctly to the emergency and getting the mask cleared and emergency air turned on will take no longer than twenty seconds. Logically you should not panic--you have plenty of air to get through the situation. So--relax, enjoy the dives and become proficient in using the Lightweight Diving System equipment.

REFERENCES

Diving Training Standards

EQUIPMENT AND MATERIALS

Swimming Trunks, Chafing Gear (or wet suits may be worn if water temperature dictates), Jack Browne Mask and Lightweight Belt.

JOB STEPS

1. Diver uses proper line-pull signals and descends to the bottom of the open tank wearing the Jack Browne Mask, Chafing Gear, and Lightweight Belt.
2. Proceed to center of tank. Flood face mask by pulling mask from your face (do not remove).
3. Clear water from mask by leaning head to left (expelling water through the exhaust valve) or back (expelling water through the seal under the diver's chin).
4. Student uses proper line-pull signals, ascends to surface and notifies topside instructor that he is going to ditch and don.

JOB SHEET 8-1-2J

5. Instructor gives OK, student uses proper line-pull signals and descends to bottom.
6. In the center of the open tank, sit down, remove weight belt and place it across your thighs.
7. Untie lifeline, making sure lifeline/air hose is not fouled.
8. Hold mask in place with one hand while loosening head straps with the other hand. With all straps loosened, slide harness over head and mask so that it is now in front of faceplate.
9. Remove mask, turn air down to a small stream, and place mask on floor of tank, under weight belt.
10. Expel all air in your lungs and wait for a signal from the in-tank instructor. Come to the surface.

CAUTION: Not expelling the air in your lungs before coming to the surface could result in an AIR EMBOLISM. The in-tank instructor is to act as a safety man to prevent you from doing this.

11. Free dive to the bottom of the tank, following the small stream of bubbles from the mask.
12. Upon reaching the area of the equipment, sit down, place the weight belt over your thighs, retreive mask and place it over your face.
13. Turn air up to normal flow, clear the mask by leaning the head to the left or back.
14. Put harness in place by taking it over the mask and head. Tighten straps, starting at the bottom.
15. Tie lifeline/airhose around waist using a slip bowline.
16. Don weight belt.
17. Give proper signals and return to surface.

SELF TEST ITEMS

1. Do you feel panic flooding your mask?
2. Do you have difficulty retaining your composure when the mask is flooded or when you are diving for the mask?
3. Are you using correct dive procedures?

JOB SHEET 8-1-3J

TITLE: Lightweight Diving System Diver--Mark I Mask (KMB-9) Emergency Air Change-over Procedures

INTRODUCTION

The KMB-9 Diving Mask and associated equipment is the most sophisticated lightweight diving system in use throughout the Navy. It has distinct advantages over previous systems and, in fact, a modified version of this system was used by the U.S. Navy Experimental Diving Unit to make the deepest open sea excursion dive (1148 feet) in 1975.

During this first dive, you will be getting acquainted with the KMB-9 Mask and learning emergency procedures. Unlike the Jack Browne, it is not necessary to ditch this system since you carry emergency air with you.

In the next unit, Underwater Tools, you will be using the KMB-9 Mask as your diving equipment, so now is the time to ask questions and, so much as possible in two dives, become competent and confident in the use of the gear.

REFERENCES

Diving Training Standards

EQUIPMENT AND MATERIALS

Swimming Trunks, Chafing Gear (or wet suits may be worn if water temperature dictates), KMB-9 Diving Mask, Lightweight Belt, Tool Bag, and Pipe Square Project Material.

JOB STEPS

1. Diver gives proper line-pull/voice communications and descends to bottom of open tank, via ladder, with pieces of Pipe Square Project in tool bag.
2. Begin Pipe Square Project as below:
    a. Place three long pipe pieces along side each other on the deck.
    b. Place four elbows in a similar area.
    c. Hold one long pipe piece and secure an elbow to each end, then back the elbows off one complete turn.
    d. Screw remaining long pipe pieces (two) into secured elbows.
    e. Secure the remaining elbows (2) to the two pipes, being sure that the elbows are aligned.
    f. Remove short pipe pieces from tool bag and screw into open elbows.

g. Screw union end on one short pipe.
h. Place union ring on remaining short pipe piece with threads facing the center of the joint.
i. Screw tail piece onto same pipe as union ring with seat facing joint.
j. Screw union ring onto union end of opposite pipe.
k. Give proper line-pull signals/voice communications and ascend, via ladder, bringing tool bag and assembled Pipe Square Project to surface.

3. At sometime during the completion of the project, the instructor will secure the primary air supply to the diver. Your reaction should be as follows:
a. At the first indication that you have lost your primary air supply, you should open the "on/off" or emergency gas supply valve. Turn toward the rear or counterclockwise to open. Secure the Steady Flow Valve Knob and Demand Regulator Adjustment Knob.
b. Use line-pull signals to request more air.
c. Inform topside, via voice communication, that you have lost the primary air supply.
d. If air is not forthcoming, request permission to abort the dive.

SELF TEST ITEMS

1. Are you relatively comfortable in the use of the gear?
2. Do you feel panic when you realize that your primary air supply is not functioning?
3. Are you using proper diving procedures?

JOB SHEET 8-1-5J

TITLE: Lightweight Diving System Diver--Searching Project

INTRODUCTION

Because of time limitations, this will be the only open water dive you will have the opportunity to make using the KMB-9 during this unit. During the dive, however, you should get a good idea of the use of the gear in shallow water work. It is maneuverable, comfortable, and safe.

You will also have the experience of wearing the Hot Water Suit during this project and, if the weather and water are cold, you will experience the effectiveness of this unique piece of equipment.

As you progress through the Searching Project using the KMB-9, remember the same project in the Underwater Basic Unit wherein you used the Mk V Deep Sea Diving System. This will really provide you a basis for comparison and, as a result, I am sure you will have an even greater appreciation for the Lightweight Diving System and, in particular, the KMB-9.

REFERENCES

Diving Training Standards

EQUIPMENT AND MATERIALS

Swimming Trunks, Shirt, Hot Water Suits, Clayton Diving Heater System, KMB-9 Diving Mask, Searching Project Material.

JOB STEPS

1. Diver uses correct line-pull signals/voice communications and descends to the bottom (at least twenty feet) via ladder and descent line.
2. Diver reports he is on the bottom.
3. Diver responds to tenders signal by moving in the correct direction.
4. Object of the search is for the diver to find the portable buoyline and, pulling it, submerge the buoy two times.
5. After locating the buoy line and submerging the buoy twice, the tenders will take you off searching signals and bring you back to the area of the descent line.
6. Diver will give proper signals and come to the surface.

SELF TEST ITEMS

1. Are you comfortable in the use of the equipment?
2. Are you aware of the differences between the Lightweight equipment and the previously used Mk V Deep Sea Diving System?
3. Are you responding properly to the tender's signals?
4. Are you using proper diving procedures?

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INFORMATION SHEET 8-2-1I

TITLE: Lightweight Diving System

INTRODUCTION

The Lightweight Diving Systems used throughout this unit is some of the most modern and popular equipment in the U.S. Navy. Surveys taken by the Naval School Diving and Salvage indicate that Lightweight and SCUBA share the popularity spotlight in fleet diving operations. This is understandable, since Lightweight or "shallow water" diving is designed for maximum depths of 90--190 feet (dependent upon equipment) and most of the diving in the fleet is done in water less than 100 feet.

The newness of the equipment, although there are many advantages, has two distinct disadvantages--availability and completeness of information. You will find that many fleet diving commands do not have the KMB-9 Mask, Hot Water Suits, or Clayton diving Heaters. At this writing, only four or five open diving bells have been manufactured, so none are currently available to the fleet commands. Most diving activities will have the Jack Browne Mask.

You, in this Student Guide plus the two manuals issued you for use during this unit, have in your possession, the most current information available on the Lightweight Diving Systems. The open diving bell information following this page was extracted from the draft of a manual written by the manufacturer, Perry Ocean Engineering, Inc.

Why, if nobody has the equipment, are you required to know it? Two reasons, really, that are somewhat related. First, as a diver, your Personnel Qualification System (PQS) requires that you are knowledgeable of the theory, operation and maintenance requirements for the equipment and, secondly, there will undoubtedly be a time when some or all of the equipment will be available to you. Hopefully, there will be a time when the gear is available to all diving commands, making the life of the working diver safer and more enjoyable.

INFORMATION SHEET 8-2-2I
TITLE: Lightweight Diving System

GENERAL DESCRIPTION

Five subsystems comprise the Diving Bell: 1. Structural, 2. Acrylic Dome 3. Gas, 4. Communication, 5. Ballast.

The bell is used as a transfer stage and diver's refuge for divers working from the surface to a maximum of 300 feet. The Bell provides a semi-dry environment and allows diver removal of diver's hats. The system is designed for shipboard use where a communication system, source of breathing medium (either mixed gas or air), and a crane for handling are available. The bell has its own umbilical connections for gas and communication lines, which are

compatible with a standard Navy umbilical.

DESCRIPTION OF ASSEMBLIES

a. Structure: The bell has four major weldments. The frame structure is the main structural weldment tying the skirt weldment, deck weldment and ballast support weldment together. The gas system, communications system and dome are mounted on the skirt weldment. The deck weldment is a platform for the divers. The ballast trays for containing the lead ballast bars are attached below the deck.

b. Acrylic Dome: The dome is formed from a sheet of 1/2 inch acrylic plastic providing the diver a partially enclosed refuge with minimum obstruction to visibility. The clear bubble also allows available light to enter the bell.

The bell with the exception of the bolts, plumbing, dome, and lead is painted with an organic zinc primer and finished with two coats of vinyl. All other items are made from non-corrosive material to provide for minimum maintenance.

c. Gas: The gas system is arranged in three modules, each attached to the interior of the skirt. Breathing gas passes through a skirt penetrator and is distributed to the modules through 1/2" copper tube. The modules consist of a right dewater and mask, left dewater and mask, and center master valve and mask with pressure gauge. At four points in the lower portion of the skirt there are vent attachments where expelled gas is carried to the exterior apex of the bell dome.

d. Communications: The bell communications consists of a waterproof speaker with interconnecting wiring to a communication connection on the exterior of the skirt. All wiring is encased in copper tubing and fittings, from the penetrator to the speaker. The speaker is mounted on the upper skirt ring. A vent line is run from the speaker to the top of the dome for pressure equalization.

e. Ballast: The ballast system is made up of twenty four lead bars with handles. Each bar weighs approximately 130 pounds and is provided with a hole through one end for a securing bolt. The bars slide into the ballast trays on PVC strips and are secured by bolts. Any number can be used to establish a desired ballast condition.

INSPECTION AND ADJUSTMENT

Upon receiving the bell and before each dive:

a. An initial check of the bell should be made to insure that no major structural damage has occured. Special attention should be given to inspecting for damage to the dome.

b. With the bell gas and communication systems connected, set gas pressure at 235 psi and turn on the communication system.

c. Enter the bell and check all valves and the oral nasal masks to be certain that they are operating properly. The dewatering valves and mask valves should be opened one at a time. When each mask valve is opened the appropriate mask should be tested for adequate flow.

d. Check the communication system to be certain that there is clear two way communication between the surface and the bell.

After extended periods of storage or shipment:

e. The bell should be manned by a diver and put in the water. Lower the bell until the top of the dome is about one foot below the water.

f. Fill the dome completely with air and with the venting gas turned off check the flange area visually for leaks.

g. With the bell back on deck, remove the non-return valve on the bell exterior and test to be certain it will not pass flow against the check.

h. Inspect the porous filters for excessive corrosion. Remove them and blow air through them to be certain they will pass gas freely. If they are blocked they should be replaced.

OPERATION

FUNCTIONAL OPERATION

The bell is connected to a source of breathing gas and a topside diver intercommunication system. The interconnections are made with a standard Navy umbilical. A crane is used to handle the bell while on deck and in the water. The bell can transport two divers to and from a work site, providing them with a breathing medium and communication with the surface.

SUPPORT EQUIPMENT AND SERVICES

A clear working area should be available on deck. A crane (with a 5 ton capacity) should be provided to move the bell from the deck area to the water and then handle the bell in the water. (Precaution: overside clearance of 10 feet is necessary for handling)

A diving intercommunication system is required for two way communication between the bell and the surface.

The bell is designed to interface both the intercommunication system and breathing gas source through a standard Navy umbilical.

Tag lines will be needed for handling the bell on the surface. Shackles should be provided for attaching the bell to the crane and turnbuckles and chains will be required to make the bell fast to the deck when not in use.

PREPARATION FOR USE

a. Attach tag lines for handling.

b. Move the bell to the dive station and remove the Herculite cover.

c. Attach the umbilical to the bell (both gas and communication connections) and set the gas pressure at 100 psi over the bottom pressure.

d. Tie off the umbilical to the lifting frame to prevent loading the gas and communication connections.

OPERATING PROCEDURES

a. BELL DEWATER SYSTEM: The bell dewater system can be operated by a central valve and two valves just below the porous filters. With the end valves open, the system can be operater by the central valve alone. If the central valve is open the two end valves will operate the dewater system independently.

As the bell is descending the dewater system can be operated to keep the water level below the lower skirt ring. On ascents it will help to eliminate fogging in the dome.

While the bell is at the working depth, if the divers are breathing the bell atmosphere, the dewater system should be opened slightly to allow a low velocity flow to continuously enter the bell. When the bell communication system is being used, this system should be turned off to eliminate excess

noise. Whenever the dewater system has been off for a period of time, (approximately one minute), it should be turned on again with a high velocity flow for purging the bell.

b. BALLAST: With all 24 ballast bars in place the bell has a negative buoyancy of 1500 pounds. Each bar provides 125 pounds of negative buoyancy. The bell can be adjusted from 1500 pounds positive to 1500 pounds negative as desired for operation.

c. HANDLING: The bell has a lift eye at the top of the main structural weldment. This is the major handling point for the bell. The crane is attached to the eye with non-rotating wire and appropriate shackles. Bell launch weight is approximately 4,300 pounds.

The bell also has eyes near the skirt (four) and near the deck (three) for attaching tag lines. These lines are attached while the bell is being handled on deck and are removed as the bell is about to enter the water. Similar procedures are used for recovery.

As the bell is lowered to the water, it is attached to the descending line. This guides the bell to the work site and prevents it from being moved by currents. The attachment to the descending line will also prevent rotation of the bell.

d. ASCENT AND DESCENT: The bell has a maximum ascent rate of 60 ft./min. and a maximum descent rate of 75ft./min. Whenever possible the ascent and descent should be made with a descending line attached for guiding the bell.

e. ORAL NASAL MASKS: For emergancy breathing, oral nasal masks are provided, which have individual supply line valves normally kept in the closed configuration. When the masks are used, the central gas valve is opened and the individual control valves for each mask are then used to pressurize the masks.

f. TOOL RACK AND LIGHTS: The bell tool rack will hold small hand tools and parts. Large tools should be secured to the deck of the bell or attached to hooks provided on the skirt exterior.

The two hand held diver's lights are secured in a bracket spring clamp assembly located on the skirt interior.

POST DIVE MAINTENANCE

After each dive, the bell should be throughly washed down with fresh water both inside and out. The oral nasal masks should be blown dry and removed for storage in a dry area. The diver's lights should be removed and placed on their chargers. The gas system should be blown out. The Herculite covers should be replaced.

BELL MAINTENANCE

The bell has been designed to be as maintenance free as possible. Maintenance will be required for the following items:

a. BOLTS: All bolts should be inspected on a regular basis to assure a secure attachment. Dome hold down bolts are particularly critical and should be checked every two days during regular operations. The hold down bolts should be torqued to 25ft./lbs.

b. DOME: If desired, small scuff marks can be removed by polishing with a buffing wheel and a polish such as Du Pont No. "7" Auto Polish and Cleaner. Attempts to polish larger scratches will create a thin spot in the acrylic. If any cracks appear in the dome, the dome should be replaced.

c. PAINT: Painting should be done as required to alleviate rust problems, particularly in areas such as the ballast trays and the lift eye. Touch up should consist of a light sanding and then a coat of Amercoat #35.

d. MUFFLERS: The porous mufflers in the dewatering system should be checked on a regular basis for corrosion. Once a week, during regular use of the bell, the porous filter mufflers should be removed and then attached to the end of an air hose and placed in water with a low pressure flow through them. If the muffler is clean it will bubble freely, if it does not, the muffler should be replaced.

e. CHECK VALVES: The gas system has three check valves. The main check valve on the exterior of the skirt should be removed and pressurized in the opposite directions and then inserted in water to be certain that the flow is checked by the valves.

f. VENT TUBES: All vent tubes should be securely attached and free from sharp bends. The plug at the top end of the speaker vent should be inspected each week to assure free flow.

g. SPEAKER: The speaker should be opened once a week during regular operations to check for water accummulation in the

base. If the gasket on the front plate dries out or cracks, it should be replaced.

TROUBLESHOOTING PROCEDURE

The following table provides a list of some possible problems and fixes for the bell:

PROBLEM	FIX
Leak in the gas system.	1. Pressurize the gas system. 2. If the leak cannot be readily located use a leak detector such as "Snoop" on all connections until found. 3. Tighten the fitting. 4. If the fitting needs replacment, remove the appropriate unit and replace the fitting then reinsert the unit using teflon tape and retest.
Dome Leak	1. For a minor leak inject a neoprene adhesive into the gasket at the leak point from the inside of the dome so that internal pressure will force it into the leak area. 2. Tighten the hold down bolts (25ft/lbs.) 3. If these steps do not eliminate leak, remove the hold down bolts and the dome. 4. Remove the gasket and clean with acetone. 5. If the gasket has deteriorated, use a new gasket. 6. Replace the gasket with a neoprene adhesive such as Plybond placed on both the gasket and the skirting. 7. Reassemble the dome and hold down mechanism.
Dome Scratch	1. If the scratch is a minor one, such as a scuff, rub it out with a buffing wheel and

	p polishing compound. (Such as Du Pont #7 Auto Polish and Cleaner) 2. If the scratch is deep and cannot be removed with buffing, do not attemt to sand it out. Replace dome.
Dome Crack	1. Replace the dome.
No Communication	1. If communications fail at depth, check the speaker vent tube to be certain it is not blocked. 2. If communication fails at the surface, the continuity of the system (including the umbilical) should be checked.

MAINTENANCE AND REPAIR

PREVENTIVE MAINTENANCE

During short term storage, the bell should be covered with the Herculite covers and stored in a dry area out of the sun. The bell should be secured to prevent overturning or sliding.

The oral nasal masks should be removed, cleaned, and dried, and then stored in a cool dry place. Flashlights should be cleaned and dried and put on their chargers.

For long term storage, the bell can be placed in its original shipping crate and stored enclosed to prevent damage to the domes.

REMOVAL, REPLACEMENT, AND REPAIR OF PARTS AND ASSEMBLIES

The assemblies in the bell are all bolted together in a manner to provide for ease in detaching and replacement. The gas system is made up of three modules. Each of these can be removed by breaking a flared fitting and removing the hold down bolts.

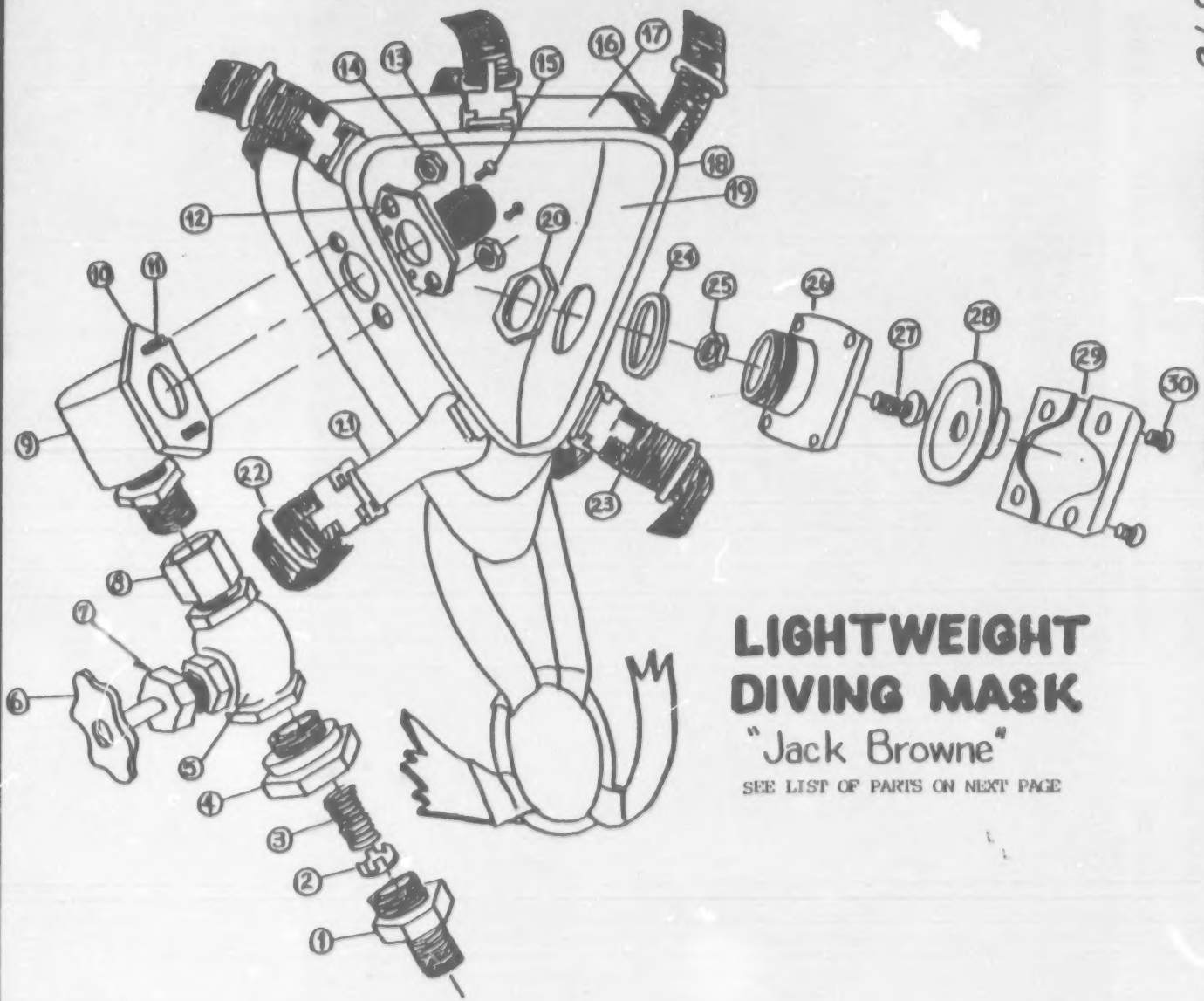
The dome assembly is held together with 36 3/8 O.D. bolts. To remove the dome, the skirt should be detached from the legs and lowered to the deck. The legs should be detached from the deck and lifted over the dome. Then the 36 hold dome bolts

should be removed. With these removed and the hold down ring removed, the dome will come off.

The ballast bars are held in by stainless rods running through the end. By removing the rods, the bars can be slid out of the trays for ballast adjustment. When a desired ballast condition is achieved, the rods can be replaced to secure the bars.

REFERENCE DATA

Diver Capacity	- 2 (3 emergency)
Design Depth	- 300 feet
Maximum Descent Rate	- 75 Ft./Min.
Maximum Ascent Rate	- 60 Ft./Min.
Overall Height	- 108 Inches
Overall Width	- 76 Inches
Weight	
With Ballast	- 4300 Pounds
Without Ballast	- 1400 Pounds
Of Ballast	- 2900 Pounds
Negative Buoyancy	- 1500 Pounds



LIGHTWEIGHT DIVING MASK

"Jack Browne"

SEE LIST OF PARTS ON NEXT PAGE

Non-Return Valve
1. Body
2. Non-Return Disc
3. Spring
4. Adaptor

Control Valve
5. 1/4 Globe Valve
6. Handle
7. Gland
8. Adaptor Nut

Inhale Valve
9. Inhale Body
10. Gasket
11. 1/2"X10-32 RHM Screw (2)
12. Flapper Plate
13. Flapper
14. #10-32 Nut (2)
15. Rivet (2)

16. Short Buckles (4)
17. Mask
18. Channel Seal
19. Lucite Window
20. Lock Nut
21. Extension Buckle
22. Harness Clips (5)
23. Head Harness W/Clips
24. Lead Washer
25. Hex Nut

Exhaust Valve
26. Exhaust Body
27. Flapper Set Screw
28. Rubber Flapper Disc
29. Cover, Exhale Valve
30. 3/8"X#6-32 F.H.M. Screw (4)

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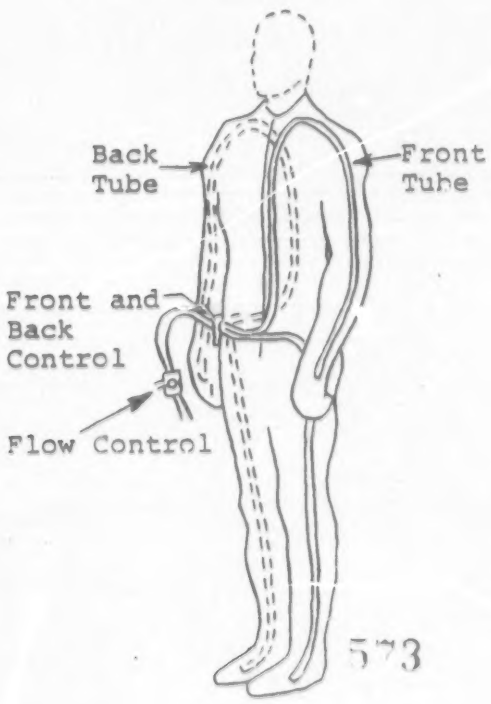
HOT WATER SUIT

Surface-supplied diving employing lightweight equipment often requires that supplementary heat be supplied to the diver. Cold water diving and protracted in-water decompression from deep and/or long bottom time exposures causes a loss of more heat to the surrounding water than the body can generate. Reduction in body temperature and associated chilling effects can occur even with the improved passive insulating characteristics of the Unisuit. In order to compensate for heat loss in demanding circumstances, a hot water suit is used.

The suit consists of a nylon lined cellular neoprene wet suit to which has been added perforated hoses along the limbs, chest and backbone areas. Hot water, supplied by hose from the surface, enters the suit through a control manifold at the diver's waist. Valves in the manifold permit control of the total water flow to the diver and, if desired, the split between front and back flow to suit the comfort needs of the diver. The water is discharged in the areas of greastest therman need and then flows within the suit to provide a balanced temperature. The water discharges around the gloves and face and partially through the zippers. This type of thermal protection eliminates the problems associated with local hot spots and broken electrodes found with electrically heated suits.

Extracted from U.S.Navy Diving Manual, Vol. II, Para. 11.1.3.1



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ASSIGNMENT SHEET 8-2-1A

TITLE: Lightweight Diving System

LESSON TOPIC OBJECTIVES

Terminal Objective
1. When the student completes this course, he will be able to, given the Planned Maintenance (PMS) requirements for the Lightweight Diving System, Mk I Mask and Hot Water Suit, correctly perform the necessary maintenance.

Enabling Objectives
1. Orally explain the maintenance requirements (periodic and usage) of the PMS.
2. Orally explain the documentation necessary for the PMS forms management.
3. For the Lightweight Diving System (Jack Brown):
   a. Orally explain the function(s) of the major components in terms of what they do for the system.
   b. Given a standard print (illustration) of the Lightweight Diving System, describe, by labeling, the physical location of the major components and component parts.
   c. List, orally, the protective devices for the major components.
   d. List, in writing, the correct ratings of the umbilical.
   e. Orally describe the nominal valve size for the Air Control Valve.
   f. List, in writing, the major materials used in the major components and component parts and explain why.
   g. Explain, orally, the function(s) of the component parts in terms of what they do for the components.
   h. Orally explain how the component parts carry out their function(s).
   i. Describe, through illustration, the flow path of the breathing media through the system.
   j. Orally state the set point(s) and reasons for the set point(s) in terms of the effects of operating above/below them as pertains to maximum depths and age of air hose in using the Lightweight Diving System.
   k. Orally describe the effect of the Lightweight Diving System due to the breathing media source.
   l. Orally describe the correct installation of the non-return valve on to the air control valve.
4. For the Mark I Mask:
   a. Orally explain the function(s) of the major components in terms of what they do for the system.
   b. Given a standard print of the Mk I Mask, describe, by labeling, the physical location of the major components and their component parts.

ASSIGNMENT SHEET 8-2-2A

c. Orally describe the sources of power for communications used with the Mk I Mask System.

d. Demonstrate and orally describe the modes of control for the side valve and second stage dial-a-breath.

e. List, in writing, the ratings for the umbilical and emergency bottle assembly.

f. Describe, in writing, the major materials used, explaining why, for the major components and their component parts.

g. Orally explain the function(s) of the component parts in terms of what they do for the components.

h. Explain, orally, how the component parts carry out their function(s).

i. Demonstrate and orally describe the modes of operation and the flow path of the breathing media through the Mk I Mask in each mode.

j. State, in writing, the maximum depth without come-home bottle, without open bell, and diving on air using the Mk I Mask, and the reasons for these maximums.

k. Orally describe the effect on this Mk I Mask System due to the umbilical, emergency bottle assembly, diver heater system, open diving bell system and breathing media source.

l. Explain, orally, the unique safety precautions of using only 120 VAC for recharging battery if amplifier is equipped with a rechargeable battery.

5. For the Hot Water Suit:

a. Orally explain the function(s) of the major components in terms of what they do for the system.

b. Given a standard print of the Hot Water Suit, describe, by labeling, the physical location of the major components and their component parts.

c. Demonstrate the operations of the velco strips.

d. List, in writing, the rating(s) of the tubing within the Hot Water Suit.

e. List, in writing, the major materials in the major components and their component parts and explain why.

f. Orally explain the function(s) of the component parts in terms of what they do for the components.

g. Orally explain how the component parts carry out their function(s).

h. Demonstrate how and where the control function is accomplished.

i. Orally describe the effect on the Hot Water Suit due to the Clayton Diving Heater System and the Mk I Mask System.

6. For the Open Diving Bell:

a. Orally explain the function(s) of the major components and their component parts.

b. Given an illustration of a typical open diving bell, locate, by labeling, the major components.

c. Explain, in writing, how the major components carry

out their function(s).

d. List, in writing, the major materials used in constructing an open diving bell and explain why.

e. Orally describe the flow path of the breathing media through the system and the pressurization of the hull body.

f. Orally explain the safety aspects of maintaining the bell in an upright position during operation.

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ASSIGNMENT SHEET 8-2-4A

TITLE: Kirby Morgan KMB-9 Band Mask(Mark I) System

STUDY ASSIGNMENT

Kirby Morgan KMB-9 Band Mask, Sections I, II, III, IV, and V. U.S. Navy Diving Manual, Volume 1, paragraph 6.1.2, 6.1.2.1, 6.1.2.2, and 6.1.2.3, Figure 6-37.

STUDY QUESTIONS

1. The KMB-9 demand regulator provides a "demand" breathing system which is adjustable for gas supplies up to _____

_____ _____ _____ _____ _____.

2. List two methods of clearing a flooded KMB-9 Band Mask.

a.

b.

3. How does the design of the KMB-9 Mask eliminate the problem of face squeeze?

4. Describe the function of the following KMB-9 components.

a. Main Frame--

b. One Way Valve Body--

c. Side Valve Assembly--

5. The amount of pressure the demand valve will hold back depends upon:

6. What function is served by the main exhaust besides discharging gas?

7. How is gas, which may leak by the face seal, exhausted?

8. What precaution is necessary in the equipment used to make up the Emergency Gas Supply System? Why?

9. Prior to diving, for what are the following items inspected?

a. Rubber Components:

b. Nose Clearing Device:

10. Prior to initially donning the KMB-9 Mask, the umbilical air/gas supply is turned on, diver places the mask on to test the systems. To what is the regulator then adjusted?

11. If use of the emergency gas supply is necessary, the diver:

12. For the following maintenance requirements, put an "M" beside those required monthly and a "D" beside those required daily.

____a. Visually inspect the interior and exterior of the mask.

ASSIGNMENT SHEET 8-2-6A

____b. Inspect the sponge muffler and replace as necessary.

____c. Test the one-way valve.

____d. Lubricate rubber exhaust valve.

____e. Check the communications system for proper operation.

13. What two problems could be assumed if a steady flow persists no matter how many turns the diver screws in the adjustment knob?

a.

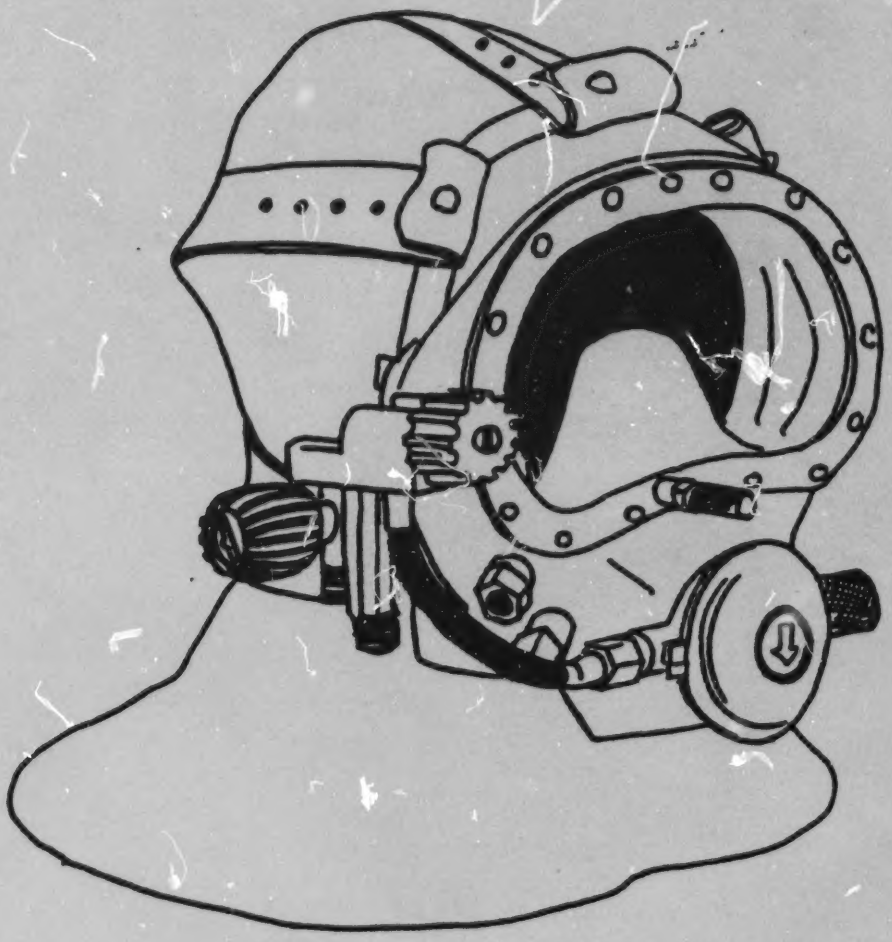
b.

14. When should the main exhaust valve be removed from the main frame?

15. What should be used to clean metal and rubber parts of the KMB-9 Mask?

16. In the illustration on the next page, label the following components:

a. Purge Button
b. Side Valve Assembly
c. One-way Valve Body
d. Demand Regulator Exhaust Outlet
e. Demand Regulator
f. Port Retainer
g. Retainer Band for Hood and Face Seal
h. Emergency Gas Supply Valve
i. Steady Flow Valve Knob
j. Nose Clearing/Equalizing Device
k. Head Harness
l. Rubber Face Seal and Hood Assembly
m. Main Frame
n. Face Seal
o. Main Gas Supply Inlet Port
p. Main Frame Exhaust Outlet



KMB-9 DIVER'S BAND MASK

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ASSIGNMENT SHEET 8-2-8A

From the Diving Manual:

17. List the depth limitations for diving the:

a. "Jack Browne" Mask:

b. USN Mark I Mask:

c. USN Mark V Mask w/open diving bell:

18. What is the capacity of the breathing bag used with the "Jack Browne" Mask?

19. What are the advantages of the USN Mark I Mask over the "Jack Browne" Mask?

a.

b.

c.

d.

e.

f.

20. List the design specifications for the lightweight air hose.

a. Working pressure--

b. Proof pressure--

ASSIGNMENT SHEET 8-2-9A

TITLE: Open Diving Bell

STUDY ASSIGNMENT

Student Guide Volume H Information Sheet 8-2-1I through 8-2-10I, Open Diving Bell.

STUDY QUESTIONS

1. The _____ structure is the main structural weldment.

2. What is the function of the vent attachments in the lower portion of the skirt?

3. What is the maximum number of lead bars that can be used for ballast?

4. When inspecting the open diving bell after a long period of storage, the non-return valve on the bell exterior should be removed and tested prior to putting the bell in the water.

   a. True

   b. False

5. What is the minimum capacity of any crane used to move the open diving bell?

6. During preparation of the open diving bell for use, the gas pressure should be set at _____ psi over the _____ _____.

7. What function is performed by the dewatering system during descent? On ascent?

ASSIGNMENT SHEET 8-2-10A

8. How many eyes are on the open diving bell? Where are they located? For what are each used?

9. List the maximum ascent and descent rates for the open diving bell.

10. What could be used to remove small scratches from the dome of the open diving bell?

11. When the bell is being used regularly, how often should the porous filter mufflers be removed and tested?

12. What is the design depth of the open diving bell?

ASSIGNMENT SHEET 8-2-11A

TITLE: Hot Water Suit

STUDY ASSIGNMENT

Student Guide, Volume H, Information Sheet 8-2-13I

STUDY QUESTIONS

1. List instances when use of a hot water suit is recommended.

   a.

   b.

2. Hot water, supplied by hose from the surface, enters the suit through a _____ _____ at the diver's waist.

3. What are the two main concerns of using electrically heated suits?

ASSIGNMENT SHEET 8-3-1A

TITLE: Clayton Diving Heater System

LESSON TOPIC OBJECTIVES

Terminal Objectives

1. When the student completes this course, he will be able to, as a member of a team tending a diver in open water, using a Mk I Mask and Hot Water Suit Systems, demonstrate/explain startup/shutdown procedures (as applicable) and operate the Clayton Diving Heater System (or other Navy approved locally available similar equipment).

Enabling Objectives

1. For the Clayton Diving Heater System:
   a. Orally explain the function(s) of the major components and component parts in terms of what they do for the system.
   b. Given a standard print of the Clayton Diving Heater System, describe, by labeling, the physical location of the major components and their component parts.
   c. Describe, by illustration, the sources of power for the major components.
   d. Describe, orally, the protection provided and the ratings of each of the major components.
   e. Orally explain how the component parts carry out their function(s).
   f. Describe, in writing, the major materials used in the component parts and explain why.
   g. Describe, by illustration, the flow path of sea water through the sea water supply system.
   h. Describe, by illustration, the flow path of steam from the auxiliary steam inlet to the auxiliary outlet.
   i. Describe, by illustration, the flow path of fresh water through the fresh water and steam systems.
   j. Describe, by illustration, the fuel flow through the fuel system to the burner.
   k. Orally describe lighting off/securing procedures.
   l. Describe, by illustration, the location at which the following is monitored: operating steam pressure, maximum and temperature to the diver, and seawater inlet pressure and flow.
   m. Orally describe the effect on this system due to a ship's auxiliary steam/condensate system, fire main system and electrical source.
   n. Orally describe the effect on the Diver's Hot Water Suit due to the operation of the Clayton Diving Heating System.

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ASSIGNMENT SHEET 8-3-2A

STUDY ASSIGNMENT

NAVSHIPS 0994-007-5010, Instruction Manual, Clayton Diving Heater, Sections I, II, IV, V, VI, and VII.

STUDY QUESTIONS

1. What is the maximum heat output of the Clayton Diving Heater?

2. What is the function of the Water Pump Snubber?

3. What component governs maximum fuel pressure?

4. If the Burner fails to ignite the fuel, what is the period of time before the Safety Switch in the Combustion Control will shut off fuel to the burner?

5. What is the function of the Temperature Limit Controller?

6. How much water is required to fill the system when cold?

7. At each start-up, it is necessary to open the inspection valve for _____ seconds to: _____ _____ _____ _____ _____.

8. What is the adjusted maximum cut-out pressure at which the Steam Pressure Switch will open and shut off the Burner?

9. What are the intervals for testing the Thermostat in order to insure continuous operation?

ASSIGNMENT SHEET 8-3-3A

10. Complete the following:

"If inlet sea water temperature is below _____,
press and hold _____ _____ _____ _____
_____ (AB) until sea water temperature rises above _____."

11. The heater water must be tested weekly for adequate chemical treatment and total dissolved solids. At what point must the heater be refilled with newly treated water?

12. List the possible cause(s) and remedy for an oil drip from the burner.

Possible Cause	Remedy

13. How often should the Fuel Filter by changed under normal conditions?

14. During a Thermostat Control test, how can you tell if the Thermostat is in correct adjustment?

15. What is the maximum allowable clearance between Thrust Plates and outside surface of Main Bearing? What two things can be done to correct excessive clearance?

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ASSIGNMENT SHEET 8-3-4A

16. What could result from leakage from the Water Pump Relief Valve?

17. Approximately how much Block Insulation would be required to completely insulate the Heating Coil?

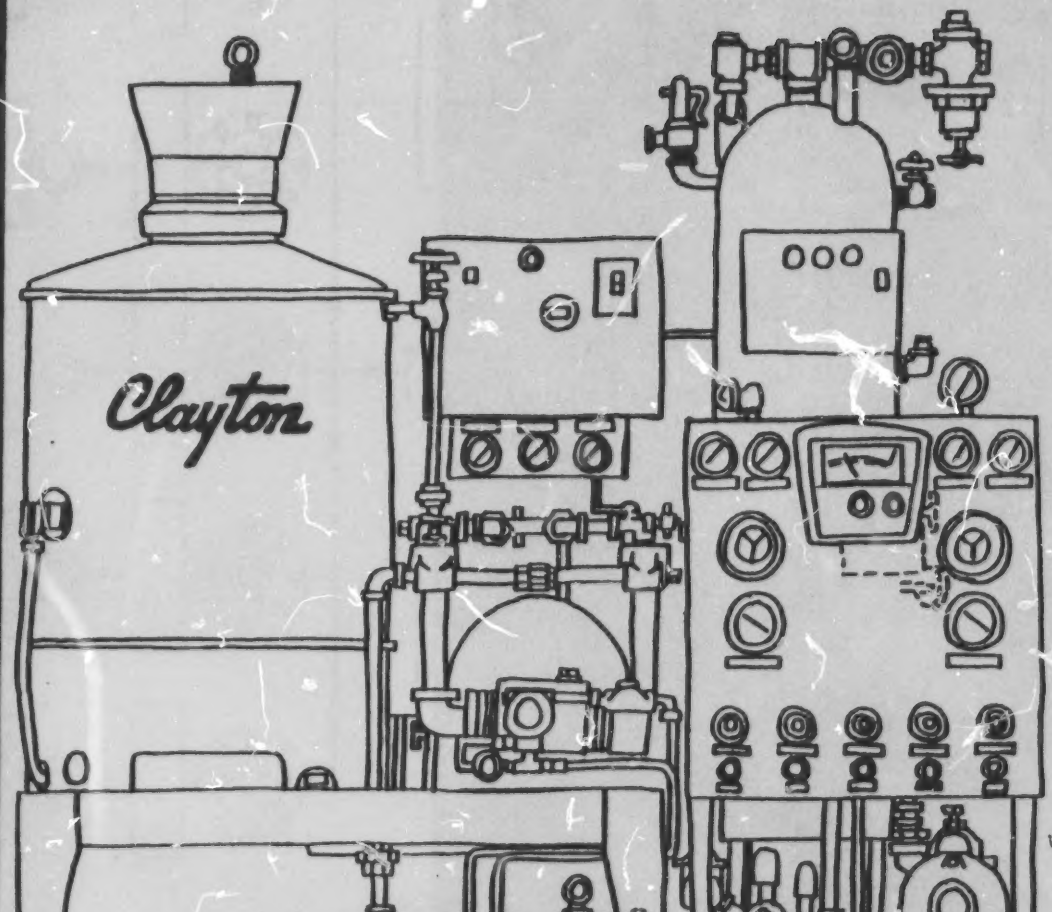
18. When adjusting the air damper, what is indicated by white smoke at the stack outlet? Black smoke?

19. What is the normal fuel pressure range?

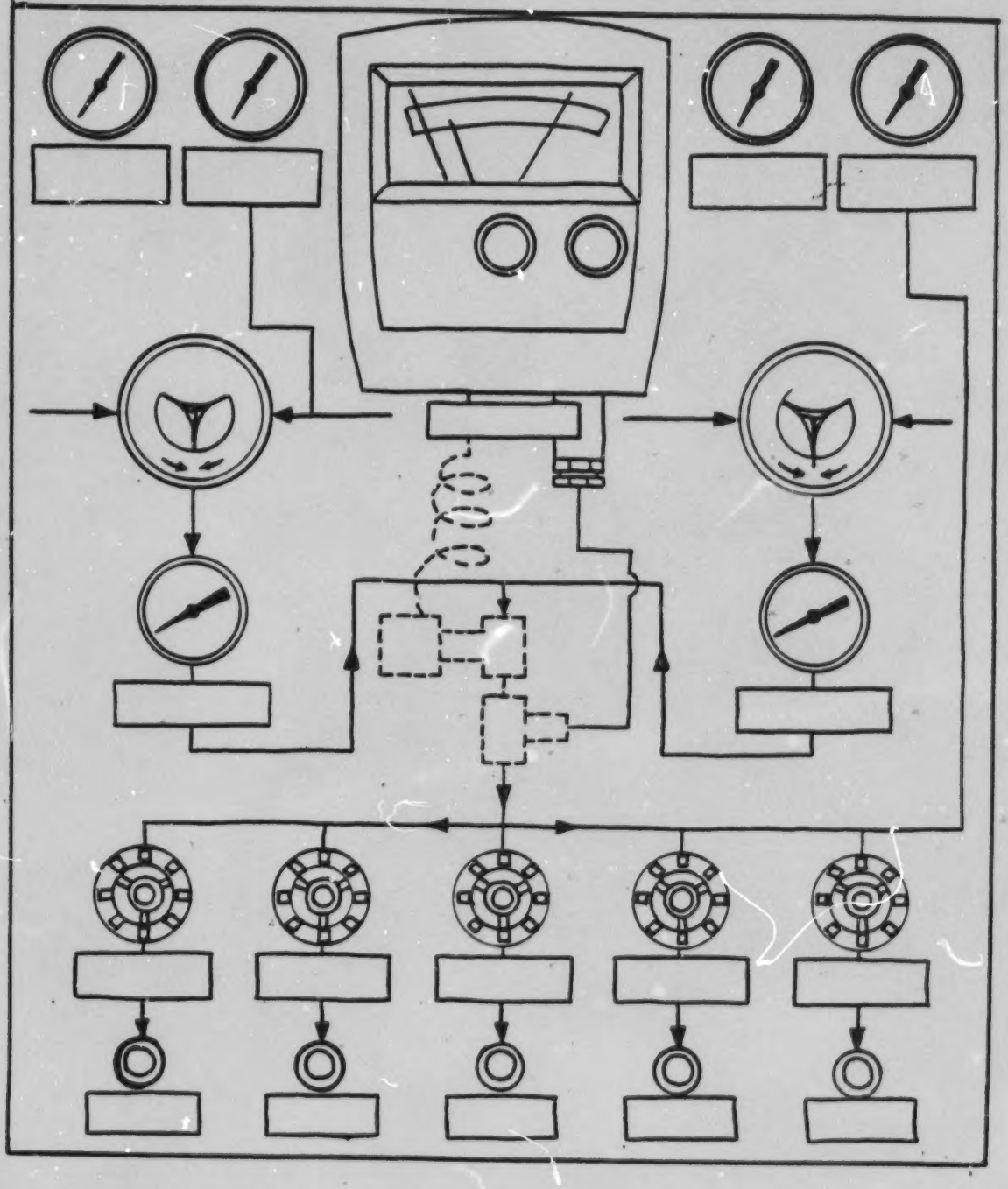
20. On the following pages are drawings of (1) the Clayton Diving Heater and, (2) Sea Water System Control Panel. Label them as follows:

(1) Clayton Diving Heater Components
- a. Sea Water Booster Pump
- b. Fuel Pressure Gauge
- c. Relief Valve, Safety
- d. Fuel Filter
- e. Hour Meter
- f. Heater Starting Switch
- g. Shut-off Valve, Hot Water
- h. Burner Control Valve
- i. Water Sample Valve
- j. Combustion Control Reset Switch
- k. Alarm Silence Switch

(2) Sea Water System Control Panel
All valves, gauges, indicators and switches.


Clayton

564 ASSIGNMENT SHEET 8-3-6A



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CLAYTON DIVING HEATER STARTING, OPERATING AND SHUT DOWN PROCEDURES

1. Start Heater with Switch (D) on Electrical Controls Panel.

CAUTION

Be sure fuel lines are open and fuel is circulating through system. If operated without fuel, the Fuel Pump will quickly score and be damaged beyond repair. On initial start, disconnect return line to fuel supply container to check flow and thus be certain that fuel is circulating.

2. Remove pipe plug from Chemical Fill Elbow marked "Add Chemical".

3. Open fresh, soft or treated Make-up Water Valve (s).

4. Prime Water Pump Valve Housings by opening Pump Bleed Valve (P) on Intake Check-valve caps until air is expelled. If Pump fails to prime, loosen Intake Valve Caps two turns (Check Valve Wrench furnished) to eliminate air; then tighten. When Plant is started initially, after storage, or if it has been idle for a long time, remove Intake and Discharge Valve Caps from Feedwater Pump Housings and wipe the Discs and Seats with a clean cloth to insure proper seating. Be sure Check-valves are installed into the same port from which they were removed.

5. If Pump fails to prime upon initial start, or if Plant is started when completely dry, close Make-up Water Valve (S) and remove Intake Valves from Feedwater Pump; then open Make-up Water Valve (s) just long enough to allow Water Pump Columns to fill completely. When Pump Columns are full, replace Check-valve caps and reopen Water Valve (S).

6. Check Water Pump for prime by throttling Coil Feed Valve (A). If pump is primed, pressure will rise on Heater Feed Pressure Gauge when Valve is nearly closed. Reopen Coil Feed Valve (A) after check.

7. Allow system to fill with soft, fresh, make-up water until level is maintained approximately 1/2" in Gauge Glass (5). This is the cold water level, when heated the water level will be maintained between 1/2 and 3/4 full in Gauge Glass (5). Close inspector's Gauge Valve (13) after correct level in Heat Exchanger has been reached and system is balanced.

NOTE

Approximately 9 gallons of water is required to fill the system when cold.

8. Add 4 ozs of Clayton Manufacturing Company water treatment chemical 1-A dissolved in 1 quart of warm water to the Heat Exchanger through Pipe Elbow (3) marked "Add Chemical". Replace pipe plug (3).

NOTE

If pressurized fresh water make-up line is not available the necessary amount of water may be introduced into the system through Pipe Elbow (3).

JOB SHEET 8-3-2J 566

CLAYTON DIVING HEATER PROCEDURES (CONT'D)

9. Once per week, add 4 ozs of Clayton Manufacturing Company water treatment chemical A-1 to the system.

IMPORTANT

Following correct Chemical treatment instructions will insure oxygen, dissolved solids, and alkalinity control. For treatment details see Feedwater Treatment Sheet (R-5235) in Clayton Diving Heater Technical Manual.

10. Open at least one Sea Water Supply Valve (J) and start Sea Water Booster Pump (4) with Switch (E).

NOTE

Never operate Pump without adequate supply of sea water (minimum 12 gpm). Adjust Sea Water Pressure Reducing Valve (K) for 40 psi delivery.

11. After starting Pump, press Reset Switch (AB) to silence alarm, and open Safety Shut-off Valve.

STARTING BURNER

NOTE

On initial start, actuate Reset (B) on Combustion Control before starting Burner. This will insure that the Control is set for a normal Burner start.

12. Be sure the correct cold water level is being maintained in the Gauge Glass (5), then fully close Burner Control Valve (R). Burner will ignite when fuel pressure rises above 10 psi.

13. Allow Plant to operate for 3 minutes then check water level in Heat Exchanger Water Level Gauge (5). Drain excess water (above 3/4 full) by opening Heat Exchanger Drain Valve (T). If more water is needed to maintain normal, correct level in Heat Exchanger (1/2 to 3/4 full), open Make-up Water Supply Valve (S) and close Shut-off Valve (M) between Heat Exchanger and Water Pump. IMPORTANT: After water level is obtained open Valve (M) and close Make-up Water Supply Valve (S).

14. Open Inspection Valve (13) for 10 seconds to bleed air from system at each start up.

AUTOMATIC OPERATION

15. The Steam Pressure Switch (SPS) will open and shut off the Burner when steam pressure rises to the adjusted maximum cut-out pressure (50 psi). When steam pressure drops to about 10 psi below the maximum, the Steam Pressure Switch will automatically cut in and restart the Burner.

16. Burner failure will actuate the Combustion Control to safety shut off about 45 seconds after failure. To restart Burner, wait 2 or 3 minutes for the thermal element to cool; acutate the Reset (B) on the Combustion Control.

CLAYTON DIVING HEATER OPERATING PROCEDURES (CONT'D)

17. Low water or water failure will actuate the Thermostat Control to stop the Burner. If the Burner shuts down due to thermostatic action find and correct the cause of insufficient water before resuming operation.

18. The Reset Button on the front of the Thermostat Switch (V) must be pressed to restart the Burner.

CAUTION

Be sure an adequate amount of water is in the system and thus eliminate any possibility of damage.

PERIODIC, OVERNIGHT, OR WEEKEND SHUTDOWN

19. Shut-off Burner by opening Burner Control Valve (R).

20. Set lower temperature limit, on Temperature Limit Controller (G), to lowest setting.

21. Allow heater to operate for five minutes then turn off Switch (D and E).

22. Flush sea water systems with fresh water by using fresh water at the sea water inlet and operating Seawater Pump.

NOTE

It may be necessary to hold in on Safety Shut-off Valve Reset Switch (AB) if fresh water temperature is too low.

* Numbers and letters in parentheses refer to Figure 4-1, Clayton Diving Heater Instruction Manual NAVSHIPS 0994-007-5010

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NOTETAKING SHEET 8-2-1N

TITLE: Lightweight Diving System - Jack Browne

REFERENCE

U.S. Navy Diving Manual, Vol. I

NOTETAKING OUTLINE

A. General Uses and Advantages

1. _____ water dives of _____ _____.
   a. _____ changes.
   b. _____ patches.
   c. Submarine _____ inspections.
   d. _____.
2. Advantages over Mk V Deep Sea System and SCUBA.
   a. Use of mask _____.
   b. Complete _____ of _____.
   c. Easily _____ in an emergency.
   d. Excellent _____.
   e. No _____ _____.
3. Safety Precautions.
   a. One of the most _____ because of _____.
      (1) Tender must be alert for accidental _____ of _____.
      (2) Never ditch mask and swim to the surface except in _____ _____.
      (3) If mask ditched or lost, _____ _____ _____ _____ _____ _____ _____.

(4) Never go _____ than necessary.

(a) loss of _____.

(b) just to check _____.

(5) Never enter a _____.

4. Limitation.

a. Practical depth _____ feet.

b. Maximum depth _____ feet.

c. Never exceed _____ limits.

B. Principles of Operation.

1. Flow path of breathing media.

a. Breathing media leaves manifold through _____ _____.

b. Passes through _____;

c. Through _____ valve;

d. Through _____ _____ valve;

e. Through _____ _____ valve _____ _____.

f. Through _____ _____ valve;

g. Circulates throughout the mask;

h. Exits through the _____ valve.

C. Umbilical.

1. Function.

a. Provides _____ _____ from surface to diver.

b. Means of _____.

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NOTETAKING SHEET 8-2-3N

2. Components

a. Supply hose.

(1) Standard _____ ID _____ hose (MIL-H-1142-A).

(2) Manufactured working pressure _____ psi.

(3) Manufactured proof pressure _____ psi held for _____ minutes.

(5) Use long _____ fittings of both _____ of hose.

(6) Hose clamps.

(a) never use _____ clamps.

(b) _____-_____ type is used.

b. Lifeline.

(1) Manufactured from _____ _____ or _____ line of equal strength.

(2) Minimum working load: _____ lbs.

(3) Three functions:

(a) remove _____ from air hose.

(b) permit _____ of diver.

(c) provides means of _____ (_____-_____).

(4) Note: Lifeline/Air Hose made up in a similar manner as Deep Sea Hose.

(a) marriages (_____) _____ apart.

(b) lifeline should be _____ overnight in _____ then stretched taut and let _____ before marrying to air hose.

D. Non-Return Valve.

1. Prevents _____.

a. Must be tested at _____ of each _____ _____. Log _____ tested.

b. Same test as with Mk V.

2. Construction.

a. _____ piece body of chrome plated _____- 1/4" _____ outlet 9/16" - _____ 02 inlet.

b. Contains Non-return _____ and _____.

3. Function.

a. Allows air to flow in _____ _____ only.

E. Air Control Valve.

1. Modified standard 1/4" _____ _____ valve.

a. Provides the diver with a means of _____ the _____ of _____ entering the mask.

b. Located at _____ level on _____ side of mask.

(1) very _____.

(2) unlikely to accidently _____ hand wheel.

c. Constructed of chrome plated _____ with

following components:

(1) Body.

(a) Contains half of _____ _____.

(b) Channels air through the valve _____.

1. mounting for _____ _____.

2. contains other _____ of seat.

(d) Bonnet.

1. recess for _____.

2. hold _____ in line with valve _____.

(e) Packing gland nut.

1. holds _____ in place.

2. provides means of tightening or loosening movement of _____.

(f) Handwheel.

1. provides diver a means of _____ or _____ valve.

I. Air Control Valve Side Mount.

1. Channels _____ into _____; provides mounting for _____ _____.

a. _____ sheet rubber - deflects air from diver's _____.

2. Functions as _____ - _____.

G. Face Mask.

1. Provides a _____ _____ for diver to _____ and _____ breathing media.

2. Covers entire face.
   a. Increased _____ of _____.
3. Manufactured from _____, heat treated _____ and _____ frame.
   a. Rubber face seal _____ to diver's face, forming _____ _____.
   b. Preformed for comfortable fit.
   c. Heat treated plexiglass.
      (1) Scratches do not _____ _____ ___ underwater.
      (2) Minimizes _____.
      (3) Easily _____, readily _____.
   d. Brass frame.
      (1) Holds plexiglass port in place.
      (2) Provides mounting surface for _____ _____ and _____.
   e. Head harness and harness clips.
      (1) Holds _____ _____ firmly to diver's face.
      (2) Allows mask to be tightened _____.
      (3) Easily _____.

H. Exhaust Valve.
   1. Allows _____ _____ of air through mask.
   2. Acts as _____ valve - allowing air to escape and preventing _____ from entering.
   3. Located on _____ side of mask at _____ level.

NOTETAKING SHEET 8-2-7N

4. Manufactured of chrome plated _____ with three major components.

   a. Body - housing for internal parts.

      (1) _____ ____ screw.

         (a) holds _____ _____ in place.

         (b) can be adjusted to regulate _____ of air leaving mask.

   b. Flapper disc.

      (1) Preformed _____.

      (2) Acts as _____.

   c. Cover plate.

      (1) _____ internal parts.

      (2) Channels _____ (_____) away from diver's line of _____.

I. Maintenance Procedures

1. Perform the following according to PMS requirements:

   a. Inspection of all equipment

      (1) Perform <u>before</u> each use:

         (a) Condition of _____/_____.

         (b) Condition of _____ _____.

         (c) Test _____ Valve.

   b. Clean, Inspect and Lubricate Equipment

      (1) Perform <u>after</u> each use:

         (a) Wash mask with _____ solution, rinse, and wipe dry.

         (b) Inspect general condition of components.

(c) Disassemble valves, inspect, clean and reassemble.

(d) Rub all leather parts with _____ _____ _____ from one side only.

(e) _____ equipment properly.

c. Testing Diving Airhose

(1) When _____ years old and every _____ months after that.

(2) Test

(a) Install test gauge adapter, test gauge, and hose fitting screw plug to end of hose.

(b) Hydrostatically test hose to _____ psi for _____ minute.

(c) Inspect the condition of all _____.

(d) Secure from test.

(e) Stow properly.

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NOTETAKING SHEET 8-2-9N

TITLE: Mk I Mask System

REFERENCES

U.S.Navy Diving Manual, Volume I
Kirby Morgan KMB-9 Band Mask Manual (Commercial Diving Division, U.S.Divers Co., Publisher)

NOTETAKING OUTLINE

A. Background

1. Mk I Dive Mask is the ninth generation of a commercial Divers face mask system designed by Bev Morgan and U.S.Divers Co.

2. The system was recently (1975) used to establish the world's open sea dive record at 1148 feet. (Experimental Diving Unit, Panama City, Florida)

3. The Mk I Mask was designed to provide the diver with extremely comfortable and durable life support and communication systems.

4. The Mk I Mask is designed so as to eliminate the possibility of face squeeze.

5. Depth Limitations:

a. Maximum - _____ feet.

b. Below _____ feet, use of an Open Diving Bell is mandatory.

c. Below _____ feet, a come home bottle is mandatory.

d. Depths may be further restricted by:

(1) _____ _____

(2) Activity _____ _____

6. KMB 8 & 10 require a side block retrofit and <u>will</u> <u>not</u> be used for diving.

a. KMB's 8 & 10 will be called into a central location for retrofit in the future.(Ref. NAVSEACOM Ltr., Nov. 1975, #1526)

7. Those KMB-9 fixed and serialized by NAVSEA are the only version of the KMB series authorized for use in diving.

a. Designation: Mk I, Mod T

b. Two other versions:

(1) Mk I, Mod O - MILSPEC Procurement issue Spring, 1976.

(2) Mk I, Mod S - Battelle Saturation System Retrofit.

B. Mask Assembly

1. Frame (Main Body)

a. Fabricated of a non-corrosive rigid _____ (cycolac).

(1) Will not carry an _____ _____.

b. Function: Supports the seven basic components:

(1) Face Port

(2) Side Valve Assembly

(3) Demand Regulator (Second Stage)

(4) Main Exhaust Assembly

(5) Hood and Face Seal

(6) Communications

(7) Oral-Nasal Mask

2. Lens "O" Ring

a. Made of a _____ _____.

b. Function: to form a watertight seal for the _____ _____.

c. "O" Ring has a tight fit.

3. Face Port

a. Fabricated of _____" acrylic plastic.

b. _____ easily.

c. NeverDull or scouring powder paste will remove most scratches.

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d. Not _____.

e. Function:

(1) _____

(2) Wide non-distorted field.

4. Port Retainer

a. Made of Chrome Plated _____.

b. Secured with 15 chrome plated brass screws.

c. Functions:

(1) Secures _____ _____ and ____ _____ in place.

(2) Maintains pressure on the "O" Ring for a watertight seal.

(3) Supports the _____ _____ device.

5. Nose Clearing Device

a. Made of chrome plated brass

b. Attached to bottom of Port Retainer.

c. _____ _____ that protrudes through the frame (main body) into the oral-nasal mask.

d. Padded with _____ rubber.

e. May be bent to fit the nose better.

f. When _____ the mask, always pull out on the nose clearing device.

g. Should use lips in conjunction with clearing device for better seal.

h. Function: to assist diver in _____ his middle ear.

i. Two "O" Rings and a nut form a watertight seal around the stem.

(1) One "O" Ring goes on before the Port Retainer.

6. Main Exhaust

a. Located at the bottom of the frame (Main Body) under the Second Stage Regulator.

b. Function: To _____ _____ from the main cavity of the mask.

c. Main Exhaust Valve

(1) Made of _____.

(2) One-way check valve.

(3) Seat for the valve is molded in the Main Body.

d. Exhaust cover made of chrome plated metal.

e. Removal of this cover permits access to the _____ Valve.

f. Cover channels exhaust back away from the diver's face.

g. Cover is secured in place by two chrome plated brass screws.

7. Communication Posts

a. Located on bottom right hand side of the frame.

b. Components

(1) Two communication posts

(2) Two washers

(3) Four Nuts

c. Connectors for head phones and mikes.

d. Connections for waterproof connectors (Marsh Marine Fittings).

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8. Side Valve Assembly

a. Located: Upper _____ side of frame.

b. _____ _____ for the emergency gas supply, gas for _____ _____ valve and supply to Second Stage Regulator.

c. Contains the on/off valve to _____ supply to the inside of the mask.

d. Contains three connections:

(1) Regulator _____ Assembly

(2) _____ Valve Body

(3) _____ _____ Valve

e. Contains an unobstructed passage for the gas supply through the center of the side valve body for all _____ of _____.

9. Side Valve Body

a. Upper section of the Side Valve Assembly.

b. Contains gas passages for all modes of operation.

c. Attachment for three fittings:

(1) Regulator Hard Piping Assembly

(2) One-way Valve Body

(3) Emergency Supply Valve

d. Contains on/off valve for the Steady Flow System.

e. Securing device for the _____ and _____.

f. Two threaded fittings secure side valve body to the frame.

g. Side Valve Body is held in place with two bolts.

h. Made of corrosion resistant _____.

i. All connections made of _____ _____ _____.

10. Gasket

a. Located between Side Valve Body and the _____.

b. Forms a watertight seal between Side Valve Body and the frame.

c. Mde of _____ neoprene rubber.

11. Muffler Sponge

a. Inside of mask on _____ side.

b. _____ sponge.

c. Function: _____ _____ and muffles noise.

12. Deflector

a. Covers the Muffler Sponge.

b. Made of chrome plated brass.

c. Contains _____ deflection holes and _____ securing hole.

d. Deflects air across face port.

13. Regulator Hard Piping Assembly

a. First connection on the Side Valve Body

b. _____ piping, soldered to the side valve body with chrome plated brass fitting to the second stage.

_____

14. One-Way Valve Body

a. Middle connection on Side Valve Body.

b. Chrome plated brass.

c. Double _____ fitting.

(1) _____ pipe into Side Valve Body.

(2) _____" - 18 male O2 fittings for umbilical connection.

d. Contains _____ for One-way Valve

15. One-Way Valve (Non-Return)

a. Located inside the one-way valve body.

b. Made by Kepner Prod. Co.

c. Made of brass.

d. _____ type valve.

e. _____ unit if it will not pass functional test.

f. Direction of flow arrow stamped on outside of valve.

g. Tested prior to _____ _____ diving.

h. Procedure for test:

(1) Do not attach the umbilical.

(2) Connect the Emergency Air Supply Valve

(3) Secure _____ _____ Valve.

(4) Open Emergency Supply Valve.

(5) Check for leaks at the _____ connection.

16. Emergency Air Supply Valve

a. Final connection on Side Valve Body

b. Chrome plated brass

c. On/off valve for Emergency Air Supply.

d. Hookup for the emergency _____ cu ft Bail Out Bottle.

e. Drilled out to _____" ID to receive the hose from the First Stage Regulator.

17. Demand Regulator

a. Modified _____ _____

b. Modified to contain the Dial-a-Breath.

c. Located on the front of the frame below the Face Port.

d. Chrome plated brass casings.

e. CRS Springs

f. Diaphragm made of _____.

g. _____ One-way Valve

h. Rubber _____ channel.

i. Function: Supplies the diver with the breathing media while on the _____ mode during the _____ cycle.

j. Supplies the diver with Steady Flow of air when required using the _____ - - _____.

k. Secondary Exhaust

l. Contains a second means of _____ mask.

18. Operation of Conshelf XII

a. Supplied with _____ from the Side Valve Body.

b. While in _____ or _____ mode.

c. Air Flows through the L.P. Piping to the Second Stage Regulator.

d. Air is checked at the Second Stage Regulator by the _____ and _____.

e. As diver inhales, the diaphragm is drawn against the lever (horseshoe)

(1) This action _____ the disc and retainer from the inlet nipple.

(2) The inlet nipple contains the _____ for the disc and retainer.

(3) Retracting the disc and retainer allows air to flow to the _____ of the regulator.

(4) Air is inhaled by diver.

(5) Air is exhaled back into the regulator and out the Secondary Exhaust.

f. Supplied with three standard springs

(1) Light spring is located on the _____ side.

(2) Heavy spring and a lighter spring are located in the Dial-a-breath.

g. All springs exert a force which tend to hold disc and retainer closed.

(1) Spring tension varies by use of the Dial-a-Breath:

(a) Turning in _____ tension.

(b) Backing out _____ tension.

h. If Dial-a-Breath is secured, air will _____ _____ to the diver.

j. Ideal for surface supply pressures of _____ - _____ psi.

l. Purge Button is located in the _____ of the Second Stage Regulator.

m. Purge Button is a _____ _____ for the springs.

n. Exhaust Port is located on the bottom of the regulator:

(1) Made of _____ _____.

(2) Secondary Exhaust

(3) Channels _____ away from diver's face.

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19. Oral-Nasal Mask

a. Located inside of the frame.

(1) Attached to Second Stage Regulator

(2) Reduces _____ _____ _____ in main cavity of mask.

(3) Prevents _____ buildup

(4) Air is inhaled from Second Stage Regulator into Oral-Nasal Mask.

(5) Exhaled back through same route.

b. Contains microphones for communications.

c. Contains a one-way rubber check valve

(1) Air from steady flow valve flows into main part of mask.

(2) Through the one-way valve into the Oral-Nasal Mask.

(3) On exhalation cycle, exhaled gas _____ one-way valve.

(4) Exhaled gas exhausts out the Secondary Exhaust.

(5) All other air is expelled out the _____ _____.

20. Communications

a. Microphone is located in the Oral-Nasal Mask

b. Right and left headphones are located in the _____ _____ in their respective sides.

c. Components

(1) Two earphones

(2) Microphone

(3) Two Communication Posts

(4) Two Washers

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(5) Four Nuts

(6) Packing Gland

(7) "O" Ring

(8) Waterproof Connector

d. Waterproof connector is a _____ terminal connector.

e. Marsh Marine Fitting

(1) 4 pin connector

(2) _____ neoprene rubber covered bronco cable

(3) 4 Cable, No. 16 Wire.

f. Normally only use _____ wires.

g. Hook spares up along side to keep out of the way.

h. Spares are used for a _____ _____.

i. Spare wires can be used with a more complex system.

j. Marsh Marine Fittings are the _____ waterproof connectors used.

k. Communication can be hooked up with _____ _____ connections

l. Produces slight loss of signal.

m. Male fittings on diver's mask.

n. Female fitting on umbilical.

o. Wires go through a packing gland that is secured to main frame.

p. Packing gland and "O" Rings form the watertight seal.

q. Wires are hooked to communication posts.

r. Topside connectors are bare wire or _____ plugs to communication box.

s. Earphones are _____ _____.

21. Hood and Face Seal

a. Made of neoprene and _____ _____ _____.

b. Forms a comfortable cushion that pushes the sealing surface of the _____ against the diver's face.

c. Will not compress with pressure.

d. Hood contains pockets which are open to the interior of the mask.

(1) Retains _____

(2) Air from mask equalize the older type earphones

(3) New types do not require equalization

e. Hood has a _____ for ease of donning.

22. Retainer Band

a. _____ bands

b. Fit around the hood and face seal combination.

c. Holds hood and face seal to the _____.

d. _____ screws hold the bands together.

e. Five spider hooks.

f. Chrome plated brass balls.

(1) Small _____ standing on the retainer band hold the balls in place.

23. Head Harness Spider

a. Five straps

b. Made of _____.

c. Used to secure the mask to the diver's head.

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24. Emergency Bottle

a. A bottle of compressed gas corresponding to the breathing mixture being _____ on the _____.

b. Bail-Out system if main system fails.

c. Standard _____ cu ft bottle used.

d. Not required unless deeper than _____ feet.

e. Use standard backpack

25. First Stage Regulator

a. From a Conshelf XII Single Hose Regulator

b. Set at _____ psi

c. Safety Valve in the L.P. side will release at _____ psi.

26. Umbilical

a. Gas Supply Hose

(1) Hewitt-Robbins Inc. NO-23-0152

(2) Gates Rubber No. 6C3 or equivalent.

(3) _____ _____ length.

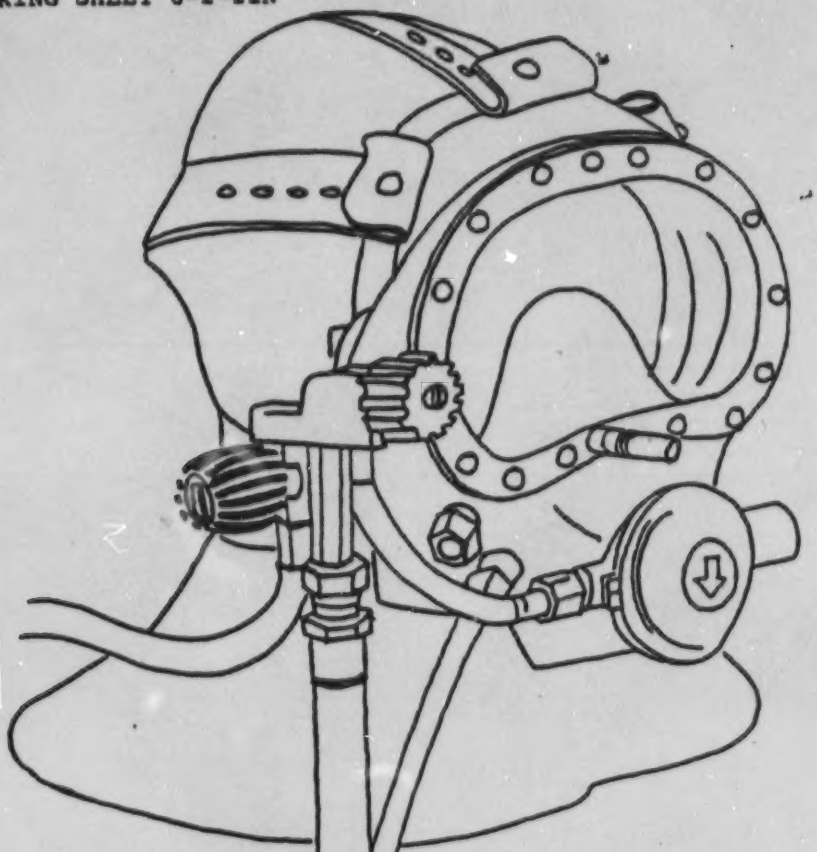
b. Smooth bore

c. _____" ID, _____" OD

d. 9/16" by 18

e. Minimum working pressure _____ psig

NOTETAKING SHEET 8-2-22N



FLOW PATH OF GAS THROUGH THE MK I MASK SYSTEM - - PRIMARY MODE

Using the drawing above, trace the air flow through the system in the primary mode as the instructor discusses it.

(1) Air Supply from Topside through the Umbilical;
(2) Enters One-way Valve Body;
(3) Through the One-Way Valve and into the Side Valve Body;
(4) Passes through the Low Pressure Regulator Hose;
(5) Into the Second Stage Regulator;
(6) Passes through the Second Stage Regulator into the Oral-Nasal Mask;
(7) CO2 exhausted out Secondary Exhaust.

On primary mode, the Steady Flow On/Off Valve is secured, Emergency Supply Valve is in the Closed position, and Bail Out Bottle open.

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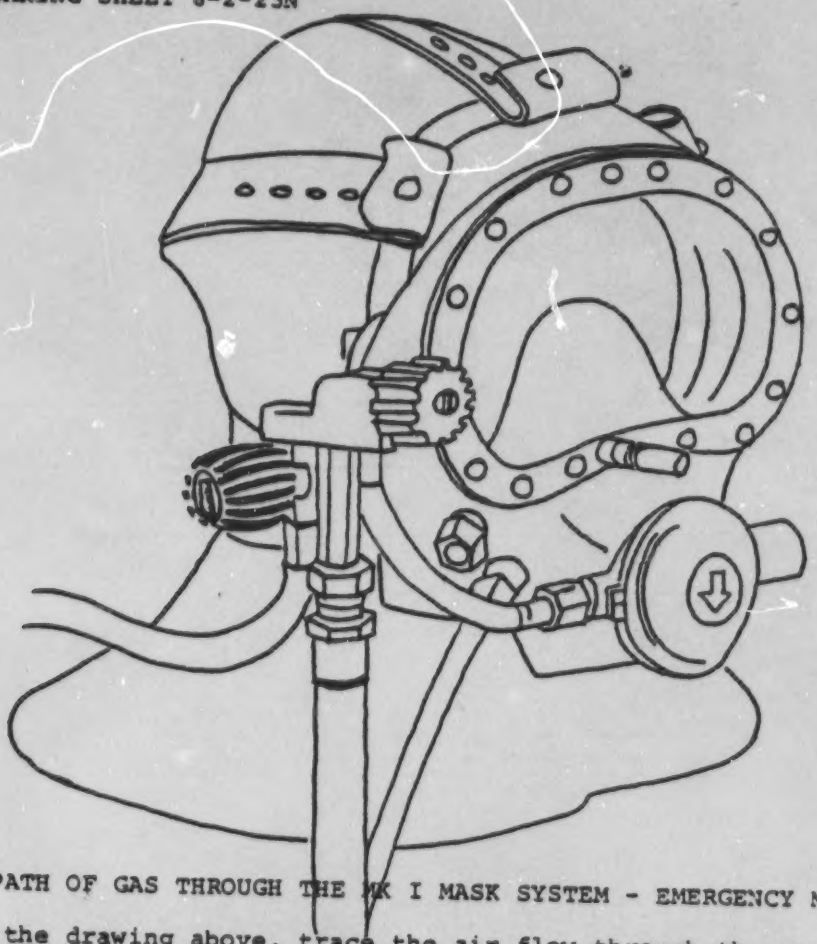
NOTETAKING SHEET 8-2-23N



FLOW PATH OF GAS THROUGH THE MK I MASK SYSTEM - EMERGENCY MODE

Using the drawing above, trace the air flow through the system in the emergency mode as the instructor discusses it.

(1) Air from 71.2 cu ft Bail Out Bottle through First Stage Regulator and hose, to the Emergency Supply On/Off Valve;
(2) Through the Side Valve Body (air to both Steady Flow and Second Stage Regulator);
(3) Into the Low Pressure Regulator Hose to the Second Stage Regulator;
(4) Into the Oral-Nasal Mask;
(5) CO2 is exhausted out Secondary Exhaust.

Steady Flow is an Emergency Mode System, but may be operated on surface supplied (primary) mode.
Steady Flow used for: Clearing face port (CO2 buildup), Clearing flooded mask.
When going on Emergency Mode:
1. Notify Topside
2. Stop all work
3. Standby for instructions

NOTETAKING SHEET 8-2-24N

C. Maintenance

1. Minimum

a. Depends upon type of _____ and _____

2. Daily

a. Visual Inspection

b. Squeeze water from _____ _____.

c. Remove hood and face seal.

d. Remove any sand or dirt

(1) Keep from scratching faceplate.

e. Check all _____ _____.

f. Check communication system

3. Monthly (or between jobs)

a. Inspect hood and face seal for tears.

b. Inspect spider.

c. Inspect and test:

(1)

(2)

(3)

d. Remove muffler and deflector assembly

e. Remove nose clearing device

(1) Lubricate shaft and "O" Rings

f. Lubricate Main _____ Valve

g. Remove Exhaust Tube

(1) Lubricate Second Stage Regulator _____ valve.

h. Remove Seond Stage Regulator Clamp

(1) Remove _____ assembly, unscrew handle.

(2) Drop out spacer, spring and piston.

(3) Clean, Lubricate and reassemble.

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NOTETAKING SHEET 8-2-25N

TITLE: Lightweight Diving System - Open Diving Bell

REFERENCES

Technical Manual for Open Diving Bell (Preliminary), Perry Ocean Engineering, Inc., 1975

NOTETAKING OUTLINE

A. General Description

1. Five Subsystems

a.

b.

c.

d.

e.

2. Open Diving Bell is used as a _____ _____ and diver's _____ for divers working from the surface to a maximum depth of _____ feet.

a. Allows diver to remove diver's _____.

b. Designed for shipboard use where a _____ system, source of _____ _____, and a _____ for handling are available.

c. Has _____ connections for gas and communications lines.

(1) Compatible with Standard _____ Umbilical

B. Description of Assemblies

1. Structure: _____ major weldments

a. _____ structure

b. _____ weldment

c. _____ weldment

d. _____ trays.

2. Acrylic Dome

a. Formed from a sheet of _____ acrylic plastic.

b. Partially enclosed _____ for divers.

c. Minimum obstruction to _____.

3. Gas System

a. _____ modules attached to interior of _____.

(1) _____ _____ and _____.

(2) _____ _____ and _____.

(3) Center _____ Valve and Mask with _____ gauge.

b. _____ Vents in lower portion of skirt.

(1) Expelled _____ is carried to the exterior _____ of the bell dome.

4. Communications

a. Waterproof speaker with interconnecting wiring to a connection on the exterior of the _____.

b. Speaker mounted on upper skirt _____.

c. All wiring encased in _____ tubing and fittings.

d. _____ line from speaker to top of dome for pressure _____.

5. Ballast

a. _____ _____ bars with handles.

b. Approximately _____ lbs each.

c. Hole in one end for _____ bolt.

d. _____ _____ can be used to establish a desired ballast condition.

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NOTETAKING SHEET 8-2- 27N

C. Inspection and Adjustment

1. Upon receipt and before each dive:

a. Initially check for major _____ damage. (Special attention given to the _____).

b. With the gas and communication systems connected, set gas pressure at _____ psi and _____ _____ communication system.

c. Enter the bell and check all _____ and the _____ _____ _____ to be certain they are operating properly. The _____ valves and _____ valves should be opened one at a time. Should be tested for adequate _____.

d. Check for _____ communication between surface and bell.

2. After extended periods of storage or shipment:

a. Man by diver and put in water. Lower the bell until the top of the dome is about _____ ft underwater-

b. Fill the _____ completely with _____ and, with the venting gas turned _____, check for _____.

c. Bring bell back on deck, remove the _____ - _____ Valve on the bell exterior and test to be certain it will not pass _____ against the check.

d. Inspect the _____ _____ for excessive corrosion. Remove them and blow _____ through them to be certain they will pass gas freely. If they are blocked, they should be _____.

D. Functional Operation

1. The bell is connected to a source of _____ _____

and a topside/diver intercommunication system. The interconnections are made with a Standard Navy Umbilical. A crane is used to handle the bell while on deck and in the water. The bell can transport _____ divers to and from a work site, providing them with a breathing medium and communication with the surface.

E. Support Equipment and Services

1. Clear _____ area on deck.
2. Crane: _____ _____ capacity.
3. Standard Navy Umbilical for Communication and Gas Supply.
4. _____ _____ for handling bell.
5. _____, _____ and chains for moving with crane and securing.

F. Preparations for use:

1. Attach _____ lines.
2. Move bell to dive station and remove _____ cover.
3. Attach _____
   a. Set gas pressure to _____ psi over bottom pressure.
4. Tie umbilical to _____ _____ to prevent _____ on connections.

G. Operating Procedures:

1. Bell Dewatering System
   a. Operated by a _____ _____ (DWV-1) and two valves below the _____ _____ (DWV-2 and DWV-3).
   b. With _____ valves open, the system can be operated by the _____ valve alone.
   c. With the Central Valve open, the two _____ valves will operate the system independently.

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NOTETAKING SHEET 8-2- 29N

d. As bell is descending, the dewatering system can be operated to keep the _____ level below the _____ _____.

(1) On ascent, it will help eliminate _____ in the dome.

e. At working depth, with the divers breathing the bell atmosphere, the dewater system should be _____ slightly to allow a low _____ flow to continuously enter the bell.

f. When using communications, turn system off to eliminate _____ _____.

g. When the dewater system has been off for a period of time (approximately _____ _____), it should be turned on again with a high velocity flow for _____ the bell.

2. Ballast

a. All 24 Ballast Bars in place provide negative buoyancy of _____ lbs.

b. _____ lb each bar.

c. Adjustable

3. Handling

a. Lifting eye at top of _____ structural weldment.

(1) Launch weight approximately _____ lbs.

b. Four padeyes near deck for tag lines.

c. After entering water, bell attaches to _____ _____.

(1) Guides to work site.

(2) Prevents _____ from current.

(3) Prevents _____.

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4. Ascent/Descent

a. Maximum ascent rate: _____ fpm

b. Maximum descent rate: _____ fpm

c. Use descent line whenever possible.

5. Oral Nasal Mask

a. For _____ breathing.

b. Individual _____ lines.

c. When in use, _____ gas valve is opened the individual controls valves are used to _____ masks.

6. Tool Rack and Lights

a. Rack for _____ tools and parts.

b. _____ tools secured to _____.

c. Two hand-held diver's lights secured.

H. Post Dive Maintenance

1. After each dive:

a. Thoroughly _____ bell down with _____ _____.

b. The Oral Nasal Masks should be _____ _____ and removed for storage in a dry area.

c. Remove diver's lights and place on _____.

d. Gas System should be _____ _____.

e. _____ _____ should be replaced.

I. Bell Maintenance

1. Bolts: check for secure attachment.

a. Dome hold down bolts checked every two days during regular operations.

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NOTETAKING SHEET 8-2- 31N

b. Torque to _____ ft/lbs

2. Dome: remove small scuff marks by _____ with a buffing wheel and polish such as DuPont No. 7.

a. Attempts to polish larger scratches will create a _____ _____ in the dome.

b. If any cracks appear, the dome should be _____.

3. Painting: as required to prevent rust.

a. Touch-up by light sanding and a coat of AMERCOAT #35.

4. Mufflers: check regularly for _____.

a. Air test once per _____.

b. Replace if necessary.

5. Check Valves

a. Main : Remove and _____ in the _____ _____ then insert in water.

6. Vent Tubes: Should be securely attached and free from _____ _____.

a. Plug at top end of the _____ should be inspected each _____, to assure free flow.

7. Speaker: opened _____ per _____ during regular operation to check for water _____.

a. If gasket on the front plate dries out or cracks, it should be _____.

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NOTETAKING SHEET 8-2-32N

Title: Hot Water Suit

Reference: U.S. Navy Diving Manual, Volume II

NOTETAKING OUTLINE

A. Introduction

1. A new concept of diving, used by Saturation Divers, but will soon be used by all divers in the fleet.
2. Allows divers to enter colder water with longer bottom times.
3. Advantages
   a. Divers stay more _____.
   b. More _____ performance.
   c. Need not worry about getting cold and not being able to finish the job.
4. Usage
   a. _____ _____ Mask
   b. Clayton Diving Heater.

B. Construction

1. _____ covered.
   a. 1/4" thick.
   b. On _____ sides for strength.
   c. _____ fitting.
      (1) Lets water _____ to keep diver warmer.
2. Hood.
   a. Built into suit.
   b. Difficult to get a seal when using the Mk I Mask.
   c. Can be modified.
3. Hot Water Tubing.

a. Cemented inside of suit.

(1) _____ ID X _____wall thickness.

b. Tubing has _____ covering.

(1) Holes in the tubing are out the _____ of the tubing.

(a) Creates better water circulation.

4. Zippers

a. Made of _____ _____.

(1) Corrosion resistent.

b. On _____ and down _____ of suit.

5. Neoprene Gloves.

a. Elbow length.

(1) Tubing on the suit extends _____ to _____ below arms of suit.

(2) Tucked inside gloves to provide hot water to hands.

b. Glove Hand.

(1) Made of 1/16" material for _____.

6. Neoprene Boots.

a. Knee length.

(1) Tubing extends 6" to 8" below legs of suit.

(2) Tucked inside of boots to provide hot water for the feet.

7. VELCRO Strips.

a. Hooks are sewn to outside of _____ and _____.

b. Pile is sewn inside of _____ and _____.

(1) Prevent them slipping off in water.

8. Hot Water Control Valve Manifold.

a. Main Body is made of _____ _____ (PVC).

(1) Non-corrosive in salt water.

b. Tubing connectors are made of _____.

c. (1) Rust and corrosive resistent.

c. Three Rotary Valves made of PVC.

(1) Non-corrosive.

(2) Used to _____ _____ of hot water to the suit.

(a) Top Valve is _____ - _____ % flow.

1. _____.

2. Controls flow to _____ and _____.

(b) Middle Valve

1. Controls flow to the _____ of the body.

(c) Lower Valve.

1. Controls flow to the _____ of the body.

9. Harness.

a. Used as a _____ _____ _____.

b. Crosses legs, chest and back which has lifting eye.

c. Made of _____ sewn and cemented to suit for _____.

10. Hot Water Hose.

a. _____ ID Rubber Hose.

b. Hose is _____ in water.

c. Snaptite fitting on _____ end (Quick Disconnect).

C. Maintenance

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NOTETAKING SHEET 8-2-35N

1. Recommended _____ to _____ hours of operation.

   a. Inspect and clean:

      (1) _____.

      (2) _____.

      (3) _____.

      (4) _____.

   b. Varies due to:

      (1) Work being done.

      (2) Type of bottom.

      (3) Water being pumped through the suit.

   c. Inspect and clean Control Valve Manifold.

      (1) Check for _____ _____.

      (2) Lubricate with _____ _____ as necessary.

   d. Inspect and clean zippers.

      (1) Lubricate with silicon grease or Zipper Ez as necessary.

   e. Removal of Crude Oil--_____ _____ neoprene if not removed.

      (1) Use _____ detergent solution or Boraxo.

      (2) _____ thoroughly with fresh water.

   f. Removal of Tar.

      (1) Any unhibited _____ _____ applied with cloth.

      (2) Scrub with detergent solution.

      (3) Rinse with fresh water.

   g. Solvents--avoid contact.

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NOTETAKING SHEET 8-2- 36N

(1) Methyl Ethyl Ketone (MEK).

(2) Laquer Thinner.

(3) Acetone.

(4) Toluene.

D. Repair of Hot Water Suit.

1. Similar to normal _____ _____ repair.

a. After cementing rips or tears, use a _____ _____.

(1) If not used, a _____ inch overlap patch should be used.

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NOTETAKING SHEET 8-3-1N

TITLE: CLAYTON DIVING HEATER SYSTEM

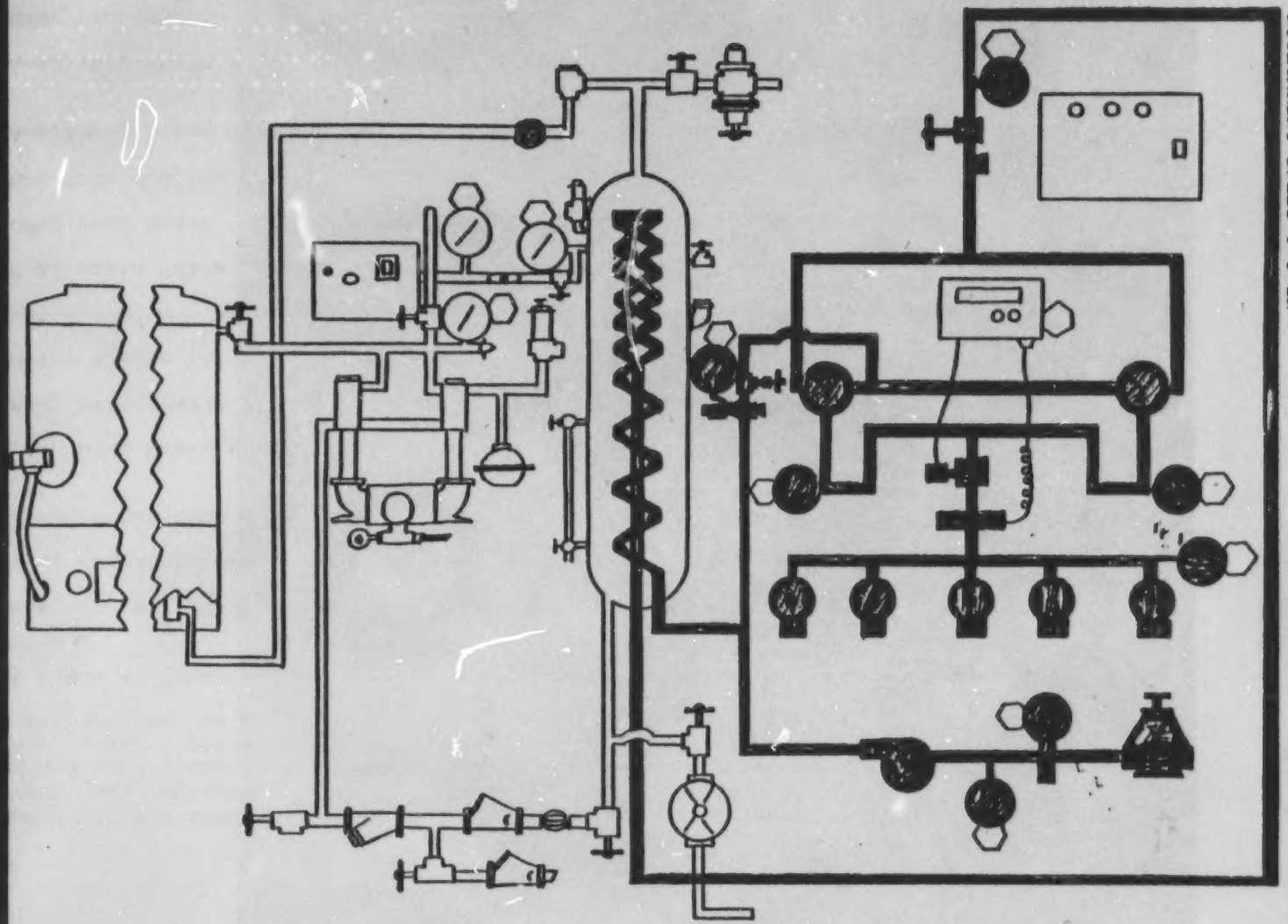
REFERENCE

NAVSHIPS 0994-007-5010, Clayton Diving Heater Instruction Manual

NOTETAKING OUTLINE

A. General Description

1. The Clayton Diving Heater System is a self-contained unit which includes a closed system heater, sea water pump and heat exchanger.
2. Temperature Control Valves automatically blend the delivery temperature of sea water for one (1) to four (4) divers.
3. If required, the unit is also equipped to use an alternate source of heat, such as "ship's steam" instead of the integral heater.
4. The unit may be separated if desired.
5. The Clayton Diving Heater System will develop its full rated pressure within _____ minutes from a cold start at the rated capacity of 550,000 BTU/Hr. The diving heater will deliver _____ to _____ gallons per minute of heated sea water within an adjustable temperature range of _____ to _____ under all conditions of sea water delivery pressure (65 to 125 psi) flow rate.
6. Temperature and pressure gauges are located throughout the system at various inlets and outlets.
7. The complete assembly is mounted on a skid frame.
8. Standard equipment includes safety devices for protection against water failure, excessive pressure and electrical overload, however, an _____ must be present during _____ of the _____.



NOTETAKING SHEET 8-3-2N

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NOTETAKING SHEET 8-3-3N

FRESH WATER AND STEAM SYSTEM - The chart above is a diagram of the Fresh water, steam and Sea Water Systems of the Clayton Diving Heater. The Sea Water System has been darkened to aid you in notetaking. Locate the components of the Fresh water and Steam System as the instructor discusses them. Using the corresponding letters (below) will aid in labeling the components.

A. Freshwater Make-up Inlet - Fills the system with properly treated water. Allows the operator to add water as necessary.

B. Make-up Water Valve - Allows operator to add make-up water to the system.

C. Heat Exchanger Drain Valve - Allows operator to drain Heat Exchanger.

D. Fresh Water Pump - Diaphragm-type pump, designed to deliver a fixed volume of water into the system during operation. Electrically powered.

E. Pump Head Drain Cock - Used to drain Fresh Water Pump.

F. Pump Bleed Valve - Used to allow trapped air to escape from pump.

G. Water Sample Valve - Used to obtain water sample for test.

H. Relief Valve - Allows excess steam pressure to vent off into the atmosphere.

I. Coil Drain Valve - Used to drain heating coil.

J. Coil Feed Valve - Allows steam heated in the boiler to pass into the Heat Exchanger.

K. Wet Tube Heating Coil - Water to be heated passes through this coil.

L. Auxiliary Steam Shut-off Valve - Used to secure steam when unit is being used with "ship's steam".

M. Auxiliary Steam Reducer - Used to regulate steam pressure.

N. Heat Exchanger - Water Heating chamber. Steam from the boiler enters the Heat Exchanger and flows around heating coil, heating the water.

O. Heat Exchanger Relief Valve - Allows excess pressure inside Heat Exchanger to vent.

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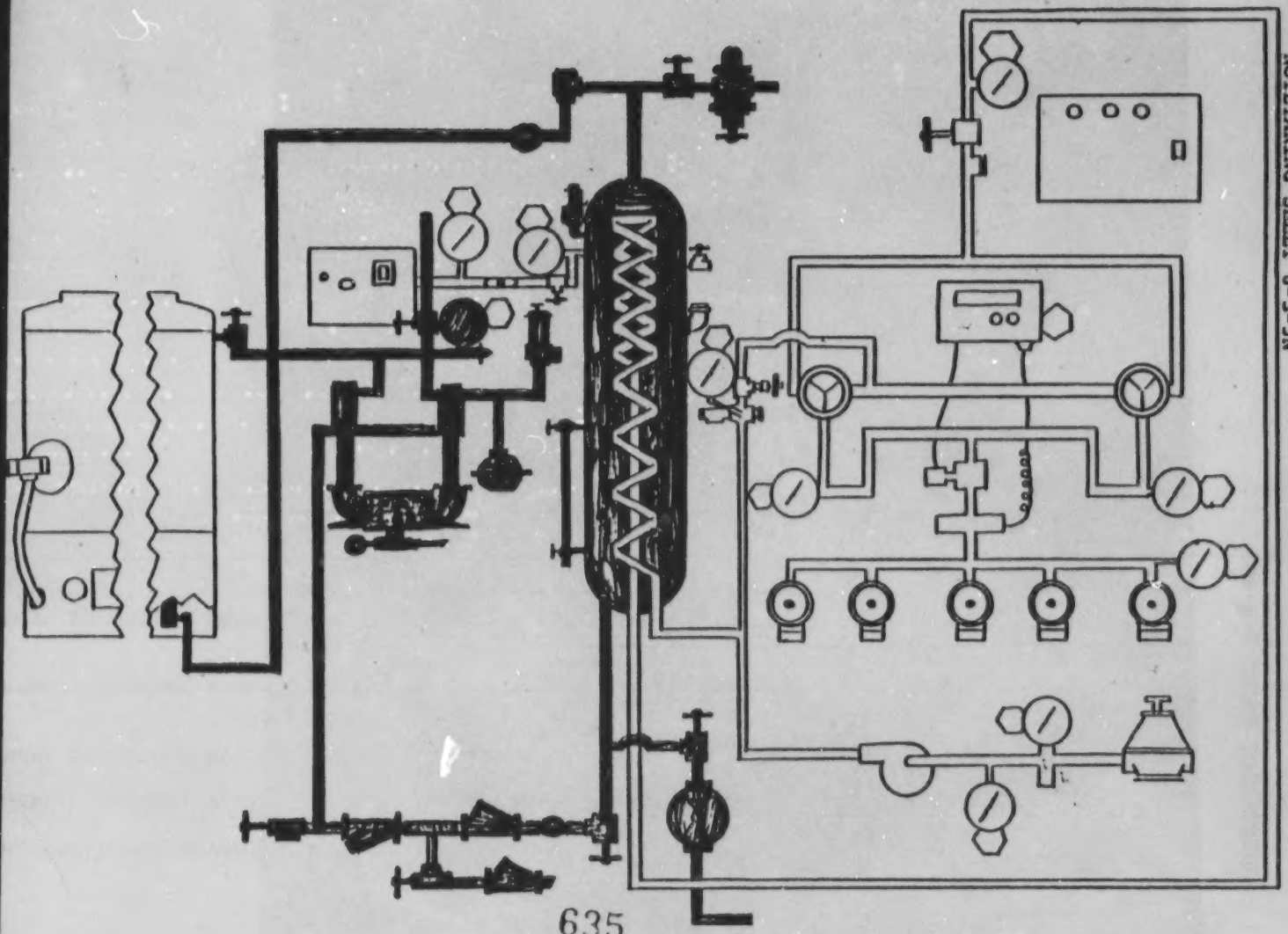
FRESH WATER AND STEAM SYSTEM (Cont'd)

P. Heat Exchanger Vent - Used during Lighting Off to allow trapped air to escape.

Q. Heat Exchanger Pressure Gauges - Allows operator to monitor pressure inside of Heat Exchanger.

R. Heat Exchanger Sight Glass - Enables operator to see level of water inside Heat Exchanger.

S. Heat Exchanger Shut Off Valve - Allows water to return to boiler.



NOTETAKING SHEET 8-3-5N

SEA WATER SUPPLY SYSTEM COMPONENTS - The chart above is a diagram of the Sea Water Supply System, Fresh Water Supply and Steam System of the Clayton Diving Heater. The Fresh Water and Steam System have been darkened to aid you in notetaking. Locate the components of the Sea Water Supply System as the Instructor discusses them. Using the corresponding letters (below) will aid in labeling the components.

A. Sea Water Pressure Reducer Valve - Regulates sea water pressure.

B. Inlet Temperature Gauge - Allows operator to see temperature of sea water.

C. Inlet Pressure Gauge - Allows operator to monitor supply pressure.

D. Supply Pump - Used to supply sea water into the sea water system.

E. Heat Exchanger Coil- Sea Water passes through this to be heated.

F. Heat Exchanger Temperature Gauge - Allows operator to monitor temperature of Heat Exchanger.

G. Temperature Regulator Valves - Used to raise or lower the water temperature to the diver. Works by allowing cold water to be added or reduced to the heated water being pumped to the diver.

H. Regulator Temperature Gauges - Enables operator to monitor water temperatures being pumped to the diver(s).

I. Sea Water Outlet Safety Shutoff Valve - Automatically closes when the heated sea water temperature is not within set limits.

J. Outlet Valve Pressure Gauge - Allows operator to monitor hot water pressure to diver.

K. Outlet Valve Manifold - Connection for Hot Water Hose

NOTETAKING SHEET 8-3-6N

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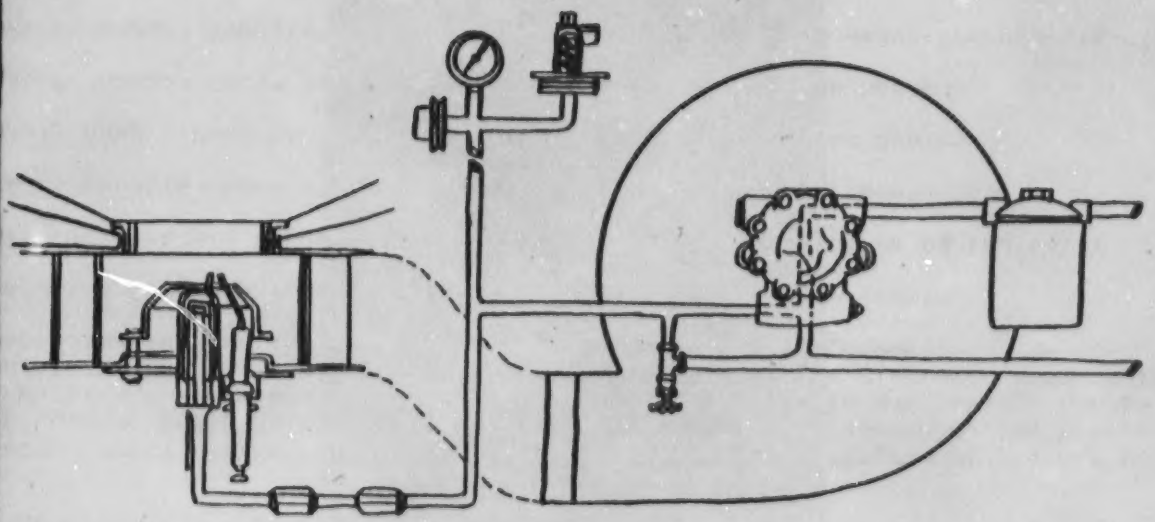

FUEL SYSTEM - The chart above is a diagram of the Fuel System of the Clayton Diving Heater System. Locate the components of the Fuel System as the Instructor discusses them. Using the corresponding letters (below) will aid in labeling the components.

A. Fuel Filter - Element type.

B. Fuel Pump - Supplies fuel to the burner.

C. Burner Control Valve - Used to increase or decrease the fuel supply to the Burner.

D. Fuel Pressure Switch - Closes and energizes the Combustion Control Switch when fuel pressure rises.

E. Fuel Pressure Gauge - Allows operator to monitor fuel pressure.

F. Burner Manifold - Location for mixing of fuel and air.

G. Blower - Supplies air under pressure to Burner.

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ELECTRICAL SYSTEM COMPONENTS

A. Heater Starting Switch

1. Located on _____ _____ _____ next to Heater.
2. When switch is on, it energizes:
   a.
   b.
   c.
   d.
   e. All _____ switches in the system.

B. Thermostat Switch

1. Located on side of Heater.
2. This is a SAFETY SWITCH.
3. When coils inside _____ expand, the switch shuts off the Burner to prevent damage to the unit.

C. Steam Pressure Switch

1. Located within the Burner.
2. _____ on switch turns Burner controls on/off.
3. Switch goes on when a drop of _____ psi occurs in steam pressure.
4. Switch shuts off when steam pressure excedes _____ _____.

D. Heater Motor

1. Located to the rear and to the right of the Heater.
2. Motor has _____ HP, _____/_____ V, _____ HZ at _____RPM.
3. Support 3 other components
   a.
   b.
   c.

NOTETAKING SHEET 8-3-10N

E. Sea Water Booster Pump

1. Located below Mixing Panel.
2. Drives a centrifugal pump in order to boost sea water pressure.
3. ____ HP, 115/230 V, 60 HZ
4. Pumps _____ to _____ GPM @ _____ psig.
5. Switch for Pump located above Mixing Panel.

F. High and Low Temperature Limit Controller and Temperature Gauge

1. Located on Mixing Panel
2. Allows operator to select a _____ and _____ temperature.
3. This is a SAFETY DEVICE.
4. If temperature rises or falls past settings, the Audible Alarm sounds.

G. Audible Alarm

1. Located within the Electric Panel Box above Mixing Panel.
2. This is a SAFETY DEVICE.
3. Indicates something is wrong.
4. Controls _____ Valve
   a. When alarm goes off, Actuator secures _____ going to diver.

H. Audible Alarm Switch On/Off and Reset Switch

1. Located on same panel as Alarm, above Mixing Panel.
2. These two switches _____ the Actuator Valve when temperature is _____ to _____.
3. Must be _____ operated.

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FOR OFFICIAL USE ONLY

STUDENT GUIDE

FOR

DIVER, SECOND CLASS (A-433-0022)

MEDICAL DEEP SEA DIVING TECHNICIAN (A-433-0020)

SHIP SALVAGE DIVING OFFICER (A-4N-0011)

DEEP SEA (HeO2) DIVING OFFICER (A-4N-0010)

VOLUME I

Underwater Tools

PREPARED BY

NAVAL SCHOOL DIVING AND SALVAGE

PREPARED FOR

SERVSCOLCOM, SDIEGO

SUBTRACENPAC, PHARBOR

NAVSCOLDIVSAL, WASH

31 OCTOBER 1975

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INFORMATION SHEET 9-1-1I

TITLE: Underwater Tools

INTRODUCTION

Through technology, underwater work has been made considerably easier for the diver, faster and more efficient with the development of underwater power tools and equipment. This has been a joint venture with the U.S.Navy and the civilian community working hand in hand. SpearHeading the effort for the Navy has been the Naval Civil Engineering Laboratory, Port Hueneme, California. The information contained within these pages provide you the latest information on the development and use of these underwater power tools.

The unit, as a whole, is designed to provide you a familarization with the equipment currently available. You will be provided instruction on the various systems as well as the opportunity to use some of them. During the completion of your projects for this unit, you will not only be using the tools doing underwater work, but you will be expected to know how to set the system up for routine operations.

HYDRAULIC TOOLS FOR DIVERS

NOTE: The following article written by S.A.Black and J.T.Quirt, Naval Civil Engineering Laboratory (NCEL), has been extracted from a larger article dealing with hydraulic tools. It is designed to provide you with an overview of the tools and power units available. Specific tools and power units will be covered later in this Student Guide and in class.

INTRODUCTION

In response to the urgent need for improved tools for divers, NCEL has conducted a research and development program that has considerably expanded the number of tools available to divers. The program was jointly sponsored by the Naval Facilities Engineering Command and the Naval Ship Systems Command through the Supervisor of Salvage.

These tools are mainly slightly modified versions of hydraulic tools designed for land use.

PROBLEMS IN DEVELOPMENT

Two basic problems associated with the development of tool power systems for diver use are (1) supplying hydraulic power to the tool in the diver's hand and (2) giving the diver tools and associated hardware that are safe and easy to operate. Table 1 (at the end of this article) lists the tool power source categories involved in this development work.

Factors influencing selection of a system are type of power available, operational costs, requirement for covertness, environmental conditions (current, sea state), operational depths, extent of work (time requirements) and power requirements of needed tools.

The hydraulic umbilical system has the most applications because most work will continue to be performed at relatively shallow depths (less than 150 feet) where this system is simple and reliable. As depth increases, hydraulic lines necessarily become larger in diameter and create both a topside and an underwater handling problem. Also, the input power required at the pump increases to overcome line losses.

To provide hydraulic power at the greater depths, it becomes prudent to use the electrical umbilical system which optimizes power transmissions and reduces handling problems. Use of bottom-supported systems is presently in the concept stage but presents no new ideas with respect to the hydraulic power source. The key point is that this requirement should be included during initial system design so that reasonable engineering trade-offs can be made.

Diver Safety and Comfort. In conjunction with the second problem, the diver must have tools that are safe and efficient and do not result in excessive diver fatigue or discomfort. Diver safety is a primary consideration. Hazards include electric shock, excessive noise and fatigue.

INFORMATION SHEET 9-1-3I

The tools must be designed to get the job done as quickly and effectively as possible while meeting fleet requirements. In addition, tools should be designed to be compatible with environmental conditions and equipment of advanced diving systems currently being developed. Diver work aids such as tethering equipment and tool holdings and carrying devices must be developed concurrently with the primary tools and accessories.

Tools are often difficult to use underwater because of poor visibility, cold, diver buoyancy and lack of adequate footing and hand holds. Diver's muscles have an increased tendency to become cramped and painful if the triggers and handles are not designed properly or if the tools produce excessive torque or vibration or are too heavy or bulky. Stiff hoses or cables and the drag of currents on such power supply lines can increase the difficulty significantly.

HARDWARE DEVELOPMENT

The hydraulic systems described below are similar in that they all consist primarily of (1) a drive unit, (2) a hydraulic pump and reservoir and (3) dual hydraulic lines. However, there are two basic types of hydraulic circuits - the open-center and the closed-center hydraulic systems.

In the open-center system, hydraulic oil is cycled continuously from the hydraulic pump through the high-pressure hose to the tool.

In the closed-center system, flow in the hydraulic hoses occurs only when the tool is in operation. Closed-center hydraulic systems are normally used when it is necessary to conserve energy, such as in a battery-powered system. When the tool is not in use, flow bypasses the hydraulic lines and goes directly from the pump to the low-pressure reservoir which eliminates power losses caused by flow through the hydraulic lines as in the open-center system.

Pressure losses in hydraulic lines are a function of the flow rate and the hydraulic circuit (i.e., size of supply and return lines and restrictions such as hose fittings) and may vary from 10 to more than 200 psi. Depending upon the system flow rates, power losses greater than 2hp may be expected. For example, a hydraulic system operating a 3 gpm with sufficient hose to reach 120 feet depths may have a pressure drop as great as 250 psi. Add to this a 40 psi drop for restrictions from hose fittings, and the total line pressure loss is 290 psi (1.3 hydraulic hp).

Both systems have advantages and disadvantages. An open-center system is better for operating in low temperature water (40° and below). Under this condition, heat generated by frictional losses of the hose and the fittings tend to reduce the viscosity of the hydraulic oil, which prevents sluggish action and stalling of the hydraulic tool. With the closed-center system and cold water, viscosity of the hydraulic oil can increase sufficiently to prevent operation of the hydraulic tool.

One advantage of a closed-center system is that energy-storing

accumulators can be used in conjunction with a pump that delivers less than the required tool power. The system is used when a tool operates on an intermittent basis such as in drilling and nut-running operations.

Diesel Hydraulic Power Units. The drive unit for the diesel hydraulic power unit is normally an air-cooled diesel engine directly coupled to a hydraulic pump. The high-pressure side of the pump is coupled to an unloading valve set to relieve system pressures in excess of the pump output characteristics.

Other components of the unit should include (1) an "in-line" oil filter to protect the hydraulic pump from foreign matter and metallic particles, (2) a manual starting bypass valve to unload line pressure and provide for easy starting of the engine diesel, (3) a pressure gauge for monitoring line pressure and (4) flow control valve and flow meter.

A commercially available hydraulic power module is presently under evaluation at NCEL and is equipped with a 20 hp air-cooled two-cylinder diesel engine as the drive unit. The hydraulic pump is directly coupled to the diesel engine and can supply 7 1/2 gpm at 2,000 psi.

The unit is equipped with pressure gauge, line filter, 20-gal oil reservoir, pressure relief valve and manual engine speed flow control. Flow rate is established by connecting a flow meter in the hydraulic line and adjusting the engine speed until the desired flow rate is read. The flow is set before connecting the tool to the system.

A second diesel hydraulic until being designed at NCEL will be equipped with a 25 hp diesel engine of the type used to drive fleet salvage pumps and generators. The system will be able to supply about 10.5 gpm at 2,000 psi. Plans are to equip the unit with a manual hydraulic flow control valve and an in-line meter.

Electro-Hydraulic Power Modules differ from diesel hydraulic units in that the drive unit is an electric motor. These units may be either mounted on shipboards, as diesel hydraulic units, or completely submersible. Where the unit is completely submersible, the electric motor must be of the submersibe type or housed in a protective container either pressure compensated or designed to withstand the hydrostatic pressures. The hydraulic pump is usually enclosed in a pressure-compensated container filled with hydraulic oil.

Electrical Umbilical Units. The first electro-hydraulic power module designed and tested by NCEL was a special-purpose unit to furnish power to a winch located on a tethered lifting device. To reduce the potential hazard of electrical shock in the diver work area, hydraulic power was chosen to drive the winch. Although this unit was designed for operating a winch, it can be used for powering diver tools.

A 440 volt 60 Hz three-phase AC generator supplies power to an electric motor housed in a nitrogen-purged and pressure compensated enclosure through an electrical umbilical from the surface support vessel. The hydraulic pump is directly coupled to the electric motor and is housed in a separate enclosure filled with hydraulic oil.

In a system of this type, it is best to install most of the hydraulic circuitry within the reservoir; in this way, the components are protected from the water. The hydraulic circuit is relatively simple. The hydraulic pump, a variable-volume piston pump that can supply 15 gpm at 1,800 psi, draws oil through a suction strainer from the reservoir. The high-pressure side is equipped with a relief valve to protect the system in the event of over-pressurization.

An accumulator is installed on both the high pressure and return lines. The high-pressure accumulator minimizes pulsation from the hydraulic pump. Pressure on the low-pressure accumulator is maintained at 3 to 5 psi over ambient by means of a modified SCUBA ragulator. A 10 to 20-micron filter protects the hydraulic pump. The system was designed to operate at depths to 600 feet.

A second electric umbilical power unit is being designed and fabricated under NCEL contract to power diver tools to depths of 850 feet. The lightweight, compact unit will weigh less than 500 pounds in air and will be able to supply a maximum of 7.5 gpm of hydraulic oil at 1,600 psi to the tool being used.

The electric motor that drives the pump and the hydraulic circuitry will be housed in a pressure-compensated cylindrical container filled with hydraulic oil. The system will operate from a shipboard generator supplying 450-volt 3-phase 60-Hz power.

Self-Contained Units. NCEL has designed, fabricated and evaluated a battery-powered closed-center electro-hydraulic power module. The module consists of battery package, switching circuit and power unit and can supply 2.2 gpm continuously at 1,500 psi for three hours. The power unit incorporates the principle of using accumulators for energy storage; thus, it can operate tools requiring flow rates greater than the pump capacities for short, intermittent periods. Figure 2 (at the end of this article) shows the approximate running timefor tools requiring flow of 0 to 6 gpm for systems with either a 2.0 or 2.5-gallon storage accumulator. In this system when the stored energy is depleted, the tool receives flow at 2.2 gpm.

The battery package consists of two 36-volt arrays of standard lead acid batteries connected in parallel to provide 240 ampere hours of energy at the required motor current draw of 80 amps. The batteries are equipped with electrolite reservoirs, immersed in non-conducting transformer oil and housed in a pressure-compensated container equipped with a gas eliminating system. Pressure compensation is attained by a rubber bladder filled with transformer oil and connected to the battery container.

A system on-off switching circuit in the battery box permits wet connecting and disconnecting of the electric cable, which allows the diver to change battery boxes as the power is depleted.

The power unit consists of a 36-volt DC electric motor directly coupled to a hydraulic pump, separated by a manifold equipped with a

rotary shaft seal. The electric motor is housed in a cylindrical pressure vessel one end of which is bolted to the manifold and sealed with an O ring. The hydraulic pump and circuit components are immersed in hydraulic oil. Table 3 (at the end of this article) summarizes the hydraulic power units developed at NCEL.

Hydraulic Tools. Several hydraulic tools are available for diver use - most models in both open and closed-center types. Impact wrenches can be used for torquing, drilling and tapping. Although hydraulic drills are available, it is better to use the impact wrench for drilling because of the possibility of the bit jamming and injuring the diver.

There are several chain saws for cutting wood under water. Disc grinders are available and can be used for cleaning surfaces, grinding nuts and grinding bevels in metal prior to welding.

Several special-purpose tools are commercially available; and with the wide variety of commercial components on the market, almost any type of tool can be converted to hydraulic power. Hydraulic rams can be used for pushing, pulling and jacking. Hydraulic cable cutters are available in several different types. Automatic hydraulic pipe cutters can be obtained to cut pipe most sizes. There are special-purpose abrasive wheel cutters which can be built from off-the-shelf hardware.

Other Hydraulic Equipment. In conjunction with hydraulic tools and equipment for diver use, NCEL is developing an underwater Construction Assistance Vehicle (CAV) designed to provide divers with a work platform for handling tools, power sources and construction equipment.

FUTURE DEVELOPMENT

The power sources and tools discussed above are by no means end products in diver tool systems. Future work will be directed toward optimizing the present systems in terms of efficiency, physical dimensions and increased power output and to developing diver tools and aids that are compatible with both the diver and the environment.

TABLE 1 - TOOL POWER SOURCE CATEGORIES

CATEGORIES	DESCRIPTION	PUMP DRIVE	GENERAL COMMENTS
SURFACE SUPPORTED Hydraulic Umbilical	Hydraulic pump & drive unit on the surface support ship	Diesel Engine Electric Motor Gasoline Engine Pneumatic Motor	Diesel Drive is presently most commonly used
Electric Umbilical	Hydraulic pump & drive unit located underwater	Electric Motor (AC or DC)	Pump and motor may be immersed in sea water, oil, or gas; combination such as motor in gas, pump in oil
BOTTOM SUPPORTED Portable	Power supply drive unit and pump, packaged as one unit - may be manned by diver or underwater vehicle	Electric Motor (AC or DC) Battery or fuel cell powered	Pump and motor may be packaged as with electric umbilical unit. Unit highly portable.
Bottom Insulation	Pump and drive unit submersible. Power supplied by habitat, bottom installation, or underwater device.	Electric Motor AC or DC	Unit not portable except within area of power supply, i.e. bottom tethered.

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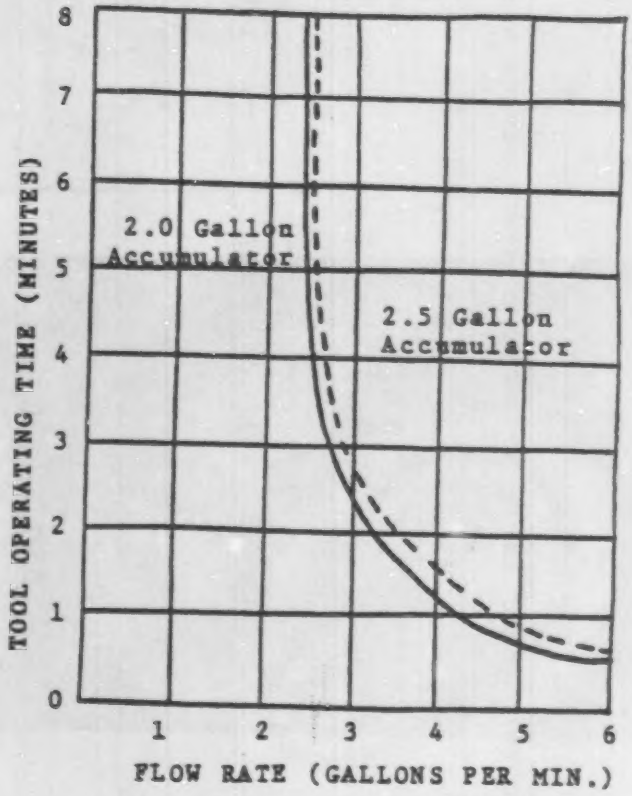

TABLE 2 - Operating time for tools requiring flow of 0 to 6 gpm

TABLE 3 - NCEL HYDRAULIC POWER MODULE

DESCRIPTION	POWER REQUIRED	CAPACITY	DIMENSIONS L X W X H	WEIGHT IN AIR	DEPTH
Commercial-type diesel hydraulic unit	20 hp Diesel	71/2gpm @ 2,000 psi	54x27x36in.	650 lbs	250 ft.
Fleet diesel hydraulic unit	25 hp Diesel	10.5gpm @ 2,000 psi	66x24x40in.	1,200 lbs	150 ft.
Cable umbilical electro-hydraulic unit	440 Volt 3-Phase 60-Hz AC	15 gpm @ 1,800 psi	30x30x48in.	1,500 lbs	600 ft.
Cable umbilical fleet electro-hydraulic	440 Volt 3-Phase 60-Hz AC	71/2gpm @1,800 psi	Combined L and girth of -9.5ft.	*500 lbs	850 ft.
Bottom-powered electro-hydraulic unit	36 Volt DC 80 amps	2.2 gpm @ 1,500 psi	40x30x30in.	1,800 lb with batteries	120 ft.

* Indicates parameters are design goals and may be changed in actual hardware.

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DIESEL HYDRAULIC POWER UNIT -- NAVSHIPS MODEL 1

The following information and drawings have been extracted from NAVSHIPS Technical Manual 0994-013-1010. For additional information and maintenance procedures for the Model 1 Diesel Hydraulic Power Unit, please refer to the above manual.

GENERAL INFORMATION

EQUIPMENT DESCRIPTION

The Model 1, Diesel Hydraulic Power Unit is a self-contained, steel-framed, skid-mounted assembly designed to provide hydraulic power up to 15 gpm at 2,000 psig. The rate-of-flow, measured in gallons per minute (gpm), is variable through the engine rpm, with which gross adjustments may be made, and a pressure-compensated flow regulator provided for fine adjustments. The maximum system pressure is variable from 150 to 2,000 psig with a hand-knob adjustable relief valve.

The unit may be used in virtually any out-of-doors environment, including those aboard ship, provided the unit is operated on a reasonably level plane. The unit is designed for diver use and is most suitable for applications where at least 100 feet of hydraulic hose is in the water. Under normal conditions, the hose in the water serves to cool the hydraulic fluid. When the unit is used without any hose in the water or during unusually hot and humid weather, it is extremely important to monitor the hydraulic fluid temperature. Hydraulic fluid temperature must be kept below 150 degrees F. to prevent pump damage. If the unit is to be used in an enclosure, provision must be made for proper engine cooling ventilation and the expulsion of engine exhaust.

AIR COOLED DIESEL ENGINE

The prime mover of the Model 1 Diesel Hydraulic Power Unit is an Onan Model DJM 120 (Spec. letter V) four-cycle vertical, in line air-cooled diesel engine with overhead valves and featuring integral crankcase and cylinders. The engine is rated at 23.7 brake horsepower (bhp) and has a normal engine speed range of up to 2,400 rpm. Other features of the prime mover include:

a. A variable-speed governor with manual lever.
b. A control panel.
c. A battery-charging flywheel alternator with rectifier/regulator.

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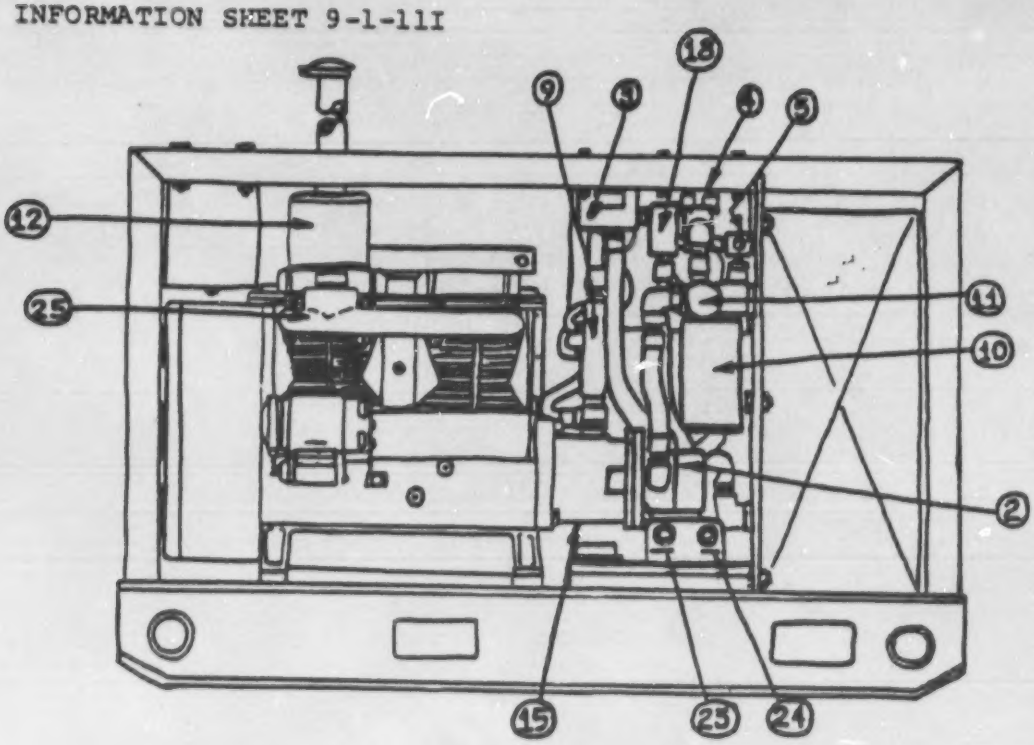
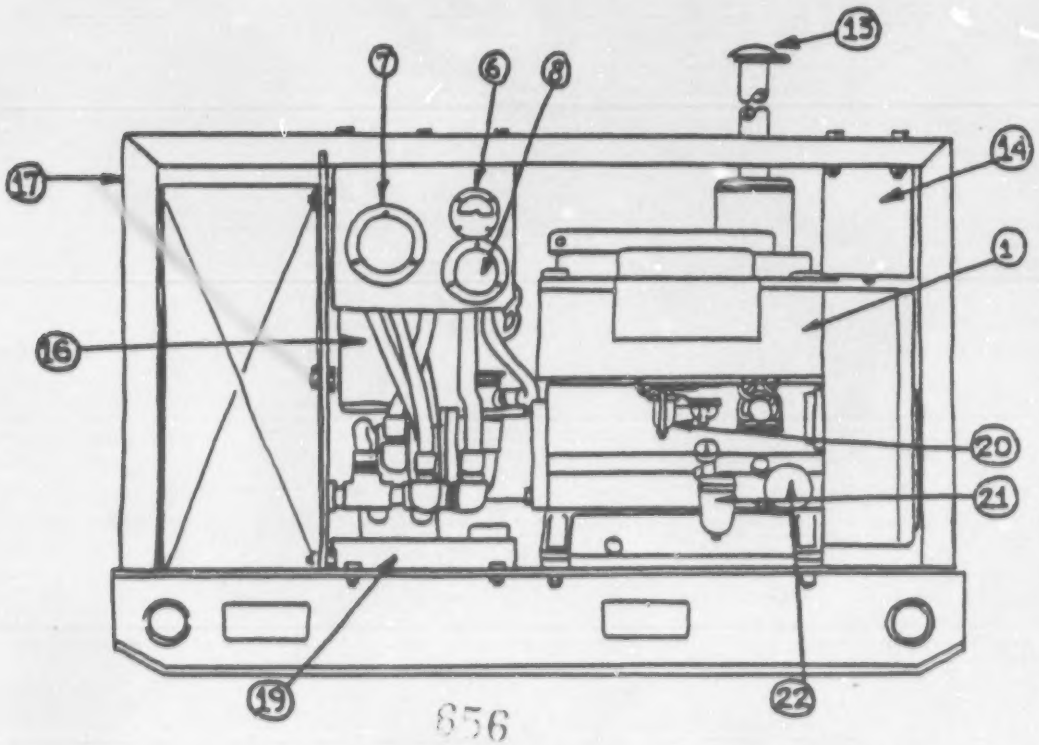


MODEL 1 DIESEL HYDRAULIC POWER UNIT



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EQUIPMENT LIST - MODEL 1 DIESEL HYDRAULIC POWER UNIT

1 - Diesel Engine
2 - Hydraulic Pump
3 - Hydraulic Flow Regulator
4 - Hydraulic Relief Valve (Adjustable)
5 - Hydraulic Relief Valve
6 - Hydraulic Flow Meter
7 - Hydraulic Pressure Gauge
8 - Temperature Gauge
9 - Flow Meter Sensor
10 - Suction Hydraulic Oil Filter
11 - Hydraulic Oil Filter Gauge
12 - Muffler
13 - Rain Cap
14 - Storage Battery
15 - Adapter (Coupling Housing)
16 - Suction Hydraulic Oil Filter
17 - Frame Assembly
18 - Fitting
19 - Fuel Tank
20 - Primary Fuel Filter
21 - Secondary Fuel Filter
22 - Oil Filter
23 - Pump Outlet (To Tool)
24 - Pump Inlet (From Tool)
25 - Exhaust Manifold

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HYDRAULIC VANE PUMP

The pump portion of the Model 1 System is an efficient, constant volume, single stage, vane-type hydraulic unit rated at 15.3 gpm at 2,000 psi and 1,800 rpm. It features a porting combination No. 00 and a clockwise rotation-keyed shaft. Basic components of the pump are:

a. A housing with a plain ball bearing, lip seal, and an inlet connection.
b. A pumping cartridge consisting of rotor, vane springs, vanes, spring guides, cam ring, and a floating port plate.
c. A shaft
d. An end cap with a needle bearing assembly and an outlet connection. The shaft is supported by the bearing in the end cap and the ball bearing in the housing. This maximum support feature allows applications with high side loading on the shaft. The pump will support a radial load of 479 pounds at the center of the keyway.

The port plate is free to move axially within limits. The output hydraulic pressure is used to counteract internal hydraulic pressure that tends to separate the elements of the pumping cartridge after the pump is primed and delievering oil under pressure. When the pump is idle and there is zero pressure in the circuit, a light spring provides the necessary clamping force to facilitate starting.

FUNCTIONAL CHARACTERISTICS

a. Denison Model TIC-011-21R Pump*

RPM	GALLONS PER MINUTE VS. PRESSURE					
	100 PSI	500 PSI	1000 PSI	1500 PSI	2000 PSI	2500 PSI
1200	11.0	10.7	10.4	10.1	9.8	9.5
1800	16.5	16.2	15.9	15.6	15.3	15.0
2400	22.0	21.4	21.6	21.1	20.8	20.5

Pump Delivery

RPM	INPUT VS. PSI					
	100 PSI	500 PSI	1000 PSI	1500 PSI	2000 PSI.	2500 PSI
1200	.9	3.7	7.0	10.5	14.0	17.5
1800	1.5	5.6	10.7	15.9	21.0	26.2
2400	1.8	7.4	14.5	21.5	28.5	36.5

Pump Horsepower Required

*The above tables are based on the use of fluid with a viscosity of 200 SSU at 100°F. MIL-H-5606B has a viscosity of 80 SSU at 100°F. Therefore, pump delivery will be approx. 20% less because of the lower viscosity.

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RECOMMENDED HYDRAULIC OIL SPECIFICATIONS*

Viscosity Range	150 to 300 SSU at 100°F
Viscosity Index	90 or above
Maximum Viscosity at starting temperature	7500 SSU
Neutralization Number	10 or below(when using new oil)
Additives	Recommend Rust and Oxidation inhibitors

*Although below the pump manufacturers' viscosity specifications, MIL-H-5606B hydraulic fluid is recommended (by NCEL) for use with the Model 1 Power Unit because of its wide-spread availability in the Federal Supply System. In an emergency, MIL-H-5606A, MIL-H-5606C or MIL-L-6083C may be used as a substitute. All of the above fluids may be mixed together.

CAUTION

The hydraulic fluid temperature must never be above 150°F with the above hydraulic fluids. Operation at higher temperatures will damage the pump.

FUNCTIONAL CHARACTERISTICS (CONT'D)

b. Onan Model DJM-120 Diesel Engine

Recommended Fuel: No. 2 diesel fuel above 32°F(0°C)
No. 1 diesel fuel below 32°F(0°C)

CAUTION

Keep fuel clean! Dirty fuel is one of the major causes of engine failure. Even the smallest amount of contamination in the fuel injection system may stop the engine.

CRANKCASE OIL GRADES VS. TEMPERATURE*

Above 30°F	SAE 30
0° to 30°F	SAE 10W or 5W-20
Below 0°F	SAE 5W-20

* Note: DM or DG Grade Oil should be used for the first 50 hours of break in; and DS (Series 3) oil thereafter.

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OPERATIONS

INTRODUCTION

All hydraulic controls and indicators are mounted on two panels; one on the front of the unit, the other on top. The electric controls are mounted on the pump end of the diesel engine under the top hydraulic panel.

CONTROLS AND INDICATORS

Hydraulic System. A panel containing the hydraulic pressure gauge, hydraulic temperature gauge, and hydraulic flow meter is located on the front of the unit. The face of each dial is clearly marked with its function.

The hydraulic pressure gauge is calibrated in pounds per square inch (psig) with a range from 0 to 3,000 psi. Under normal operating conditions, the pressure gauge should never exceed 2,000 psig.

The hydraulic temperature gauge is calibrated in degrees Fahrenheit with a range from 30°F to 240°F. The remote element sending unit for the temperature gauge is installed in the hydraulic reservoir. Under operating conditions, the temperature should not exceed 150°F.

The hydraulic flow meter is calibrated in gallons per minute (gpm) with a range from 4 to 20gpm and is used to measure the rate of flow of the hydraulic fluid as the system is operated. The rate of flow is controlled by the FLOW (GPM) CONTROL knob.

A panel containing the FLOW (GPM) CONTROL knob, the PRESSURE CONTROL knob and the engine hour meter is located on the top of the unit. Each control and indicator is clearly labeled with its function.

The rate-of-flow (gpm) of the hydraulic system is controlled by FLOW (GPM) CONTROL knob and is monitored by the hydraulic flow meter. The rate-of-flow is increased by turning the knob counterclockwise.

The system pressure is controlled by the PRESSURE (PSI) CONTROL knob and is monitored by the hydraulic pressure gauge. The pressure is increased by turning the knob clockwise.

A sight gauge, mounted on the left side of the hydraulic reservoir, is provided to measure the level of the fluid in the reservoir. The unit must be resting on a level surface to ensure

an accurate level indication. The level of the fluid must never be allowed to fall below the LOW mark on the gauge.

CAUTION

Check the fluid level frequently when using new tools and lines because of the extra fluid required to fill them. Add fluid as required.

Electric Control System. The electric controls consist of a glow plug (PREHEAT) switch, a FUEL SOLENOID switch and a START switch. These controls are located on the pump end of the diesel engine. Their functions are described later. An electric hour meter is located on the top hydraulic control panel.

OPERATING PROCEDURES

CAUTION

The hydraulic reservoir must have a sufficient quanity of hydraulic fluid prior to starting the engine. If the unit is allowed to operate without fluid, serious damage to the pump will result.

ENGINE OPERATION

Bleeding the Fuel System. Remove the fuel return line and operate the priming level on the fuel transfer pump until bubbles cease to appear in the fuel flowing from the bleed hole. Retighten fuel line. If the pump lobe on the camshaft is up, crank the engine one revolution to permit hand priming. When finished return the priming lever to the disengaged position for normal operation.

Break-In Procedure. The diesel engine has been run and tested for about 3 ro 4 hours at the factory. Additional break-in time is required and will vary, depending upon load conditions, oil used, etc. Load during break-in should be between one-half load and rated load, preferably near the rated load for best results. This procedure results in faster break-in time and lower oil consumption. Apply the load for a new or reconditioned engine in four steps, waiting 30 minutes between each step.

Starting.

a. Check level of hydraulic oil, diesel fuel and diesel lube oil (dip stick inside oil fill cover).

b. Connect hydraulic lines to tool and power unit.

c. Close FLOW CONTROL knob by turning clockwise until it stops. Be sure locking knob has not engaged before flow control valve is completely closed.

d. When starting a cold engine in air temperature above 55°F, push the PREHEAT button and hold for 20 seconds. NOTE: for air temperatures below 55°F, refer below (LOW TEMPERATURES).

e. Continue to hold PREHEAT button, push the FUEL SOLENOID switch to "ON" and press the START switch.

f. Release the START switch after the engine starts and reaches speed. Lube oil pressure should read at least 20 psi.

g. When the engine is to be restarted after short periods of shut down, preheating is usually not necessary. NOTE: The PREHEAT button is part of the starting circuit and must be depressed along with the START switch to provide power to the engine starter motor.

Stopping.

a. Turn FLOW CONTROL knob and PRESSURE CONTROL knob clockwise until closed.

b. Turn off FUEL SOLENOID switch.

c. Disconnect tool and hydraulic hose.

d. Replace dust caps on all quick connect fittings.

e. Wash all equipment which has been exposed to salt water or salt spray with fresh water. NOTE: Do not wash down the diesel unit until it is completely cooled.

High Temperatures.

a. See that nothing obstructs the air flow to and from the engine.

b. Be sure the room is properly ventilated.

c. Keep the cooling fins clean. (See that air housings are properly installed and undamaged).

Low Temperatures.

a. Use the proper SAE oil for existing temperature conditions. Change the oil only when warm from running. If an unexpected temperature drop causes an emergency, move the engine to a warm location or apply heat directly to the oil base until the oil flow freely.

b. Preheat for 1 minute if the temperature is between 30° and 50°F. Preheat for 2 minutes in ambients below 30°F. If the engine fails to start after cranking for 1 minute, preheat for 1 minute more and reattempt the start.

c. Protect fuel from condensation.

d. Keep batteries in a well-charged condition.

e. Reduce room ventilation, but use care to avoid overheating.

Protection for Extended Out-of-Service Periods.

a. Run engine until thoroughly warm.

b. Drain the oil base while still warm. Attach a warning to refill before operating.
c. Service the air cleaner.
d. Lubricate the governor linkage. Protect from dirt by wrapping with a clean cloth.
e. Plug exhaust outlet to keep out moisture and dirt.
f. Clean the entire unit. Coat parts likely to rust with light grease or oil.
g. Provide a suitable cover for the entire unit.
h. Disconnect battery and follow standard battery storage procedures.

HYDRAULIC SYSTEM

Setting Maximum Operating Pressure. Most hydraulic tools are designed for a maximum pressure of 2,000 psig. For these tools the PRESSURE CONTROL knob should be turned clockwise until it stops. For hydraulic tools with a maximum pressure below 2,000 psig, use the following procedures:

a. Start the diesel engine.
b. Disconnect the high pressure hydraulic line at the power source.
c. Open the FLOW CONTROL knob (counterclockwise) one-half turn.
d. Turn the PRESSURE CONTROL knov (counterclockwise to decrease pressure, clockwise to increase pressure) until the pressure gauge shows the maximum recommended working pressure of the tool.
e. With the FLOW CONTROL knob still open, turn off the diesel engine by pushing the FUEL SOLENOID switch to its "OFF" position. When the pressure gauge indicates 0 psi, turn the FLOW CONTROL knob clockwise until it stops. Reconnect the high pressure hose and start the diesel engine.

Setting Flow Rate. The ONAN is a constant specd diesel, therefore, flow rate is controlled by the FLOW CONTROL VALVE. The pump begins to pump hydraulic fluid as soon as the engine is started. The rate-of-flow may further be varied with the FLOW (GPM) CONTROL knob. To get the correct flow rate for a tool:

a. Connect the tool to the power unit.
b. Start the engine.
c. Open the FLOW CONTROL knob (turn counterclockwise) until the correct flow rate (from tool manufacturers' handbook) is indicated on the flow gauge on the front control panel.

Changing Tools. Before a new tool can be hooked to the power unit, the pressure in the hydraulic lines must be allowed to drop to 0 psi. This most easily accomplished by the following procedure:

a. With the diesel running, close the FLOW CONTROL knob completely (turn clockwise).

b. When the pressure has dropped to 0 psi, disconnect the tool from the hydraulic lines and replace with new tool.

c. Reset flow rate. NOTE: If a tool becomes accidently disconnected during operation, immediately shut off diesel engine. Leave FLOW CONTROL knob open until pressure drops to 0 psi. Close FLOW CONTROL knob (turn clockwise) and reconnect tool.

EMERGENCY SHUT-OFF

In an emergency, the best way to shut down the hydraulic power unit is to punch the FUEL SOLENOID switch to the off position.

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FUNCTIONAL DESCRIPTION

DIESEL HYDRAULIC POWER UNIT, MODEL 1

The following components and associated equipment comprise the Model 1 Diesel Hydraulic Power Unit.

a. An Onan Model DJ120 (Spec Letter V) 24 hp, air cooled, four cylinder in-line diesel;

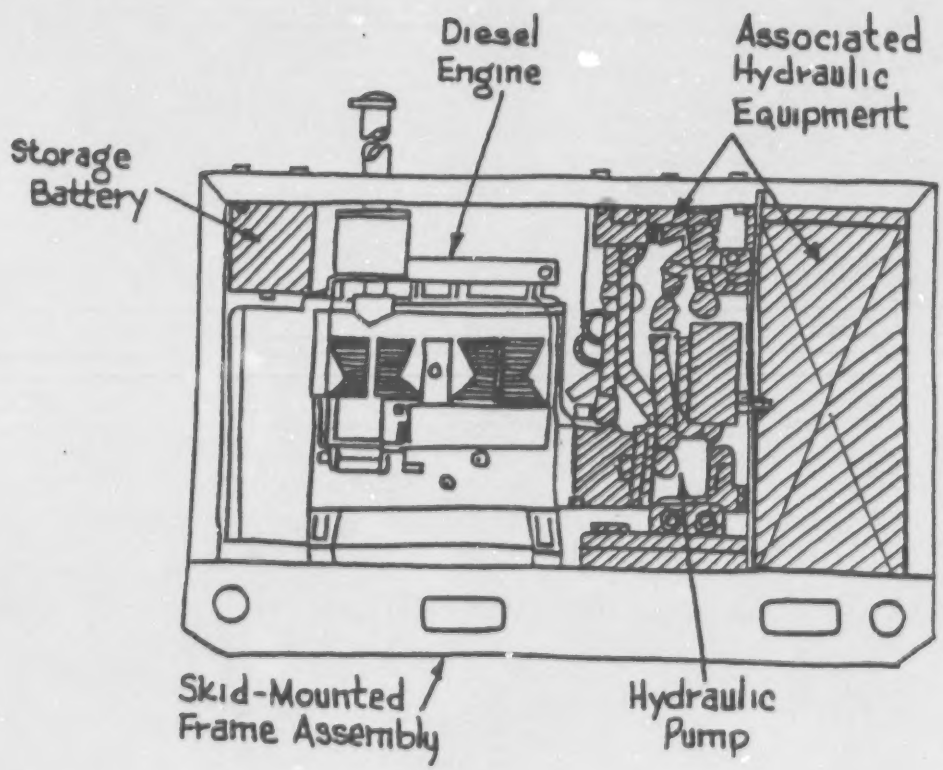
b. A Denison Model TIC-011-21R vane type, single stage, constant volume hydraulic pump.

c. A 12-volt commercial storage battery.

d. A skid-mounted frame assembly.

e. Associated hydraulic equipment, included valves, gauges, fittings, hoses, 30-gallon hydraulic oil reservoir, and filters.

f. Electrical Engine Controls



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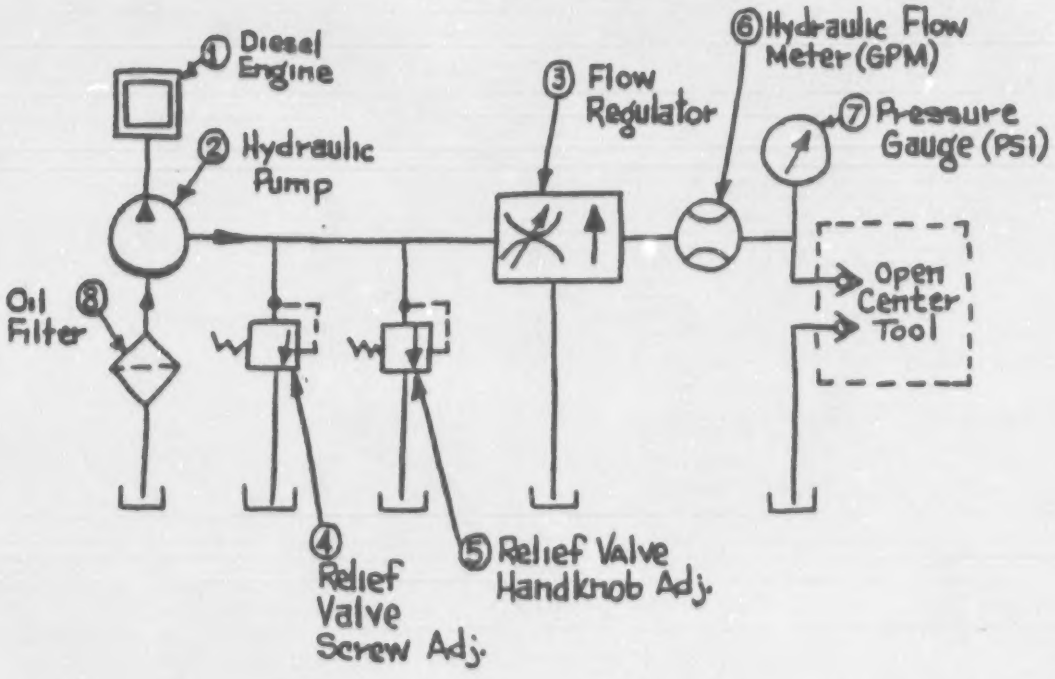
HYDRAULIC CIRCUIT

The diesel engine (1) drives the hydraulic pump (2) which provides hydraulic power of 15 GPM at 2000 PSIG and 1800 RPM. A 33-micron, disposable element type hydraulic oil filter (8) is installed in the pump suction line. Two relief valves are installed in the pressure line; one (4) is a screw adjustable type and is pre-set to a maximum pressure of 2000 PSIG (to prevent the operator from inadvertently setting the system pressure above the maximum permissable), and the other (5) a hand-knob adjustable type mounted on the panel and marked PRESSURE (PSI) CONTROL. With this control the operator may vary the system pressure from 150 PSIG to the pre-set maximum (2000 PSIG).



HYDRAULIC CIRCUIT SCHEMATIC

A variable, pressure-compensated hydraulic flow regulator (3) is provided to allow the operator to vary the rate-of-flow to the tool from 0 to 15 GPM. This control is marked FLOW (GPM) CONTROL. The rate-of-flow may be monitored by the panel-mounted hydraulic flow meter (6). The system pressure may be monitored by the panel mounted pressure gauge (7). A valved, quick-disconnect nipple and coupling are provided for connection of standard 3/4 inch tool lines, one for pressure and the other for return.

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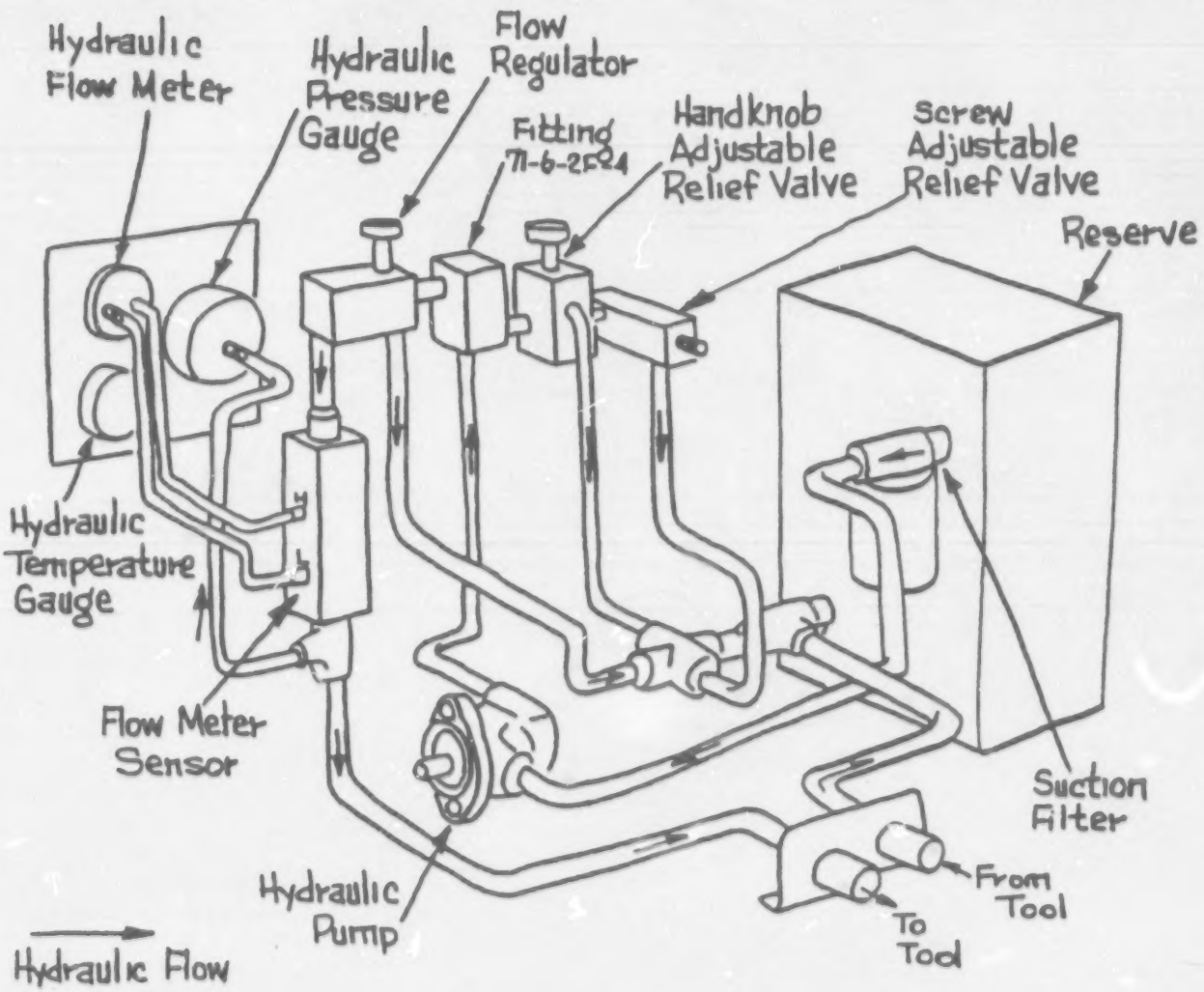
HYDRAULIC CIRCUIT (CONT'D)

A remote-element temperature gauge, calibrated from 30°F to 240°F is panel mounted to monitor the temperature of the hydraulic fluid. The fluid temperature remote element is installed in the hydraulic reservoir.



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HYDRAULIC SYSTEM - FLOW DIAGRAM

ELECTRICAL CIRCUITRY

The diesel engine starting circuit consists of a glow-plug (PREHEAT) switch, a FUEL SOLENOID switch, a START switch, a Prestolite starting motor, a fuel solenoid, four glow plugs, and two manifold heaters. The starting sequence is explained in OPERATING PROCEDURES. The components of the battery charging circuit are a flywheel alternator, a voltage regulator, and a full-wave rectifier. A fuse protects the rectifier. On newer models, including Spec Letter V, the battery charge voltage furnished by the flywheel alternator is regulated by solid state rectifiers within the combination regulator-rectifier mounted on the blower housing. There is no adjustment in the regulator.

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SUMMARY OF UNDERWATER TOOLS APPROVED FOR USE BY U. S. NAVY DIVERS

TOOL: Diesel Hydraulic Power Source SIZE: 20" x 36" x 60"

MANUFACTURER: Naval Coastal Systems Laboratory SHIPPING WT: 1300 lbs

MODEL: NAVSHIPS Model 1 FUEL TANK: 5 gals.

ENGINE: ONAN Model DJM 120
23.7 BHP @ 2400 rpm HYDRAULIC REVERVOIR: 30 gals.

HYDRAULIC PUMP: DENISON MODEL:
T1C-011-21R
15.3 GPM @ 2000psi
and 1800 rpm OIL: MIL-5606-B

ACCESSORIES: Medium Pressure Hydraulic Hose

REMARKS: Designed to power open centered hydraulic tools including: Impact wrenches, Grinders, Sump Pumps, Cutoff Wheels, Cleaning Brushes, Etc.

MAINTENANCE: Engine: as specified by manufacturer. Hydraulic System: Change oil and flush every 100 hrs or when water intrusion is detected. Hydraulic Filters: Replace when gauge indicates or after water intrusion.

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INFORMATION SHEET 9-1-26I

TOOL: Grinder

MANUFACTURER: Ackley

MODEL: 24HS-OC

INPUT: 6-12 GPM
800-2000 psi

OUTPUT: 4750 rpm at 10 gpm

SIZE: 14" long x 9" diameter

WEIGHT: 11 lbs in air

ACCESSORIES: 3/16" hex key on Tee handle. Open end wrench 11/4" x 15" x 1/4". Socket head cap screw 1/4-28, with wide shoulder (15/16" washer welded to screw to form shoulder).

REMARKS: NOTE: Grinding wheel composition should have soft grit or soft bond for underwater use. Various brushes and wire cups can be used with this grinder.

USAGE: Cup type wheels: removing masses of metal beveling edges, grinding weld beads. Disc type: removing nut heads or bolts, cutting through wire rope or chain links, removing welded zincs, welded rope guards.

CAUTION: Grinder should never be operated topside without guard or eye protection. Grinding wheels used underwater should not subsequently be used topside due to the danger of fragmentation.

MAINTENANCE: Rinse thoroughly in fresh water, wipe dry and spray with WD-40 or equivalent. For long storage, separate handle from motor, clean, lubricate and reassemble.

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TOOL: Impact Wrench with 3/4" Square Drive

OUTPUT: 2 impacts/revolution 1050 rpm at 3 gpm

MANUFACTURER: Ackley

SIZE: 17" long x 6" diameter

MODEL: 13 HS-OC

WEIGHT: 13 lbs in air

INPUT: 3-4 gpm

ACCESSORIES: Socket Set, 3/4 to 1" bolt capacity

REMARKS: USAGE: Impacting of bolts and nuts 1" - 1 1/2"

CAUTION: Exceeding recommended flow rate (gpm) will cause metal chipping in impactor. Chips will jam gears. Excessive impacting or ordinary steel will strip threads or shear bolts.

MAINTENANCE: Field strip forward portion (impact section). Wipe clean and replace grease. Spray tool with WD-40 or equivalent and reassemble.

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TOOL: Impact Wrench with 5/8" Quick Change Chuck

OUTPUT: 2 impacts/revolution
950 rpm at 5 gpm

MANUFACTURER: Ackley

SIZE: 17" long x 6" diameter

MODEL: 6HS-OC

WEIGHT: 10.5 lbs in air

INPUT: 4-6 PM
500-1500 psi

ACCESSORIES: Jacob's Chuck 1/8" - 5/8" capacity #3 chuck key.

REMARKS: NOTE: Jacobs chuck #3B recommended for durability. Chuck modified by addition of 5/8" hex quick change shank and zerk grease fitting. Chuck key modified by addition of handle.

USAGE: Drill holes up to 3/4" diameter. Tap holes up to 1/2" diameter (mild steel or softer). Impacting of bolts and nuts 3/8" - 1". Misc. attachments include screwdrivers, allen wrenches, wood augers, etc.

CAUTION: Exceeding recommended flow rate (gpm) will cause metal chipping in impactor. Chips will jam gears. Excessive impacting or ordinary steel will strip threads or shear bolts.

MAINTENANCE: Field strip forward portion (impact section). Wipe clean and replace grease. Spray tool with WD-40 or equivalent and reassemble.

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INFORMATION SHEET 9-1-29I

TOOL: Sump/Jetting Pump

MANUFACTURER: Ackley

MODEL: 2250H-OC

INPUT: 4-12 gpm
1000-2000 psi

OUTPUT: 5500 rpm at 12 gpm
up to 250 gpm water
with an 80 ft. head

SIZE: 13.5" long x 12" diameter

WEIGHT: 56.5 lbs in air

ACCESSORIES: Falcon nozzle, Balanced Tee nozzel

REMARKS: Pump can be located on the seafloor for jetting and trenching. Diver operates on-off control. Pump can be used for swamped boats, bilges, confined fuels, etc.

MAINTENANCE: Initial-disassemble completely and replace existing grease with waterproof marine grease. Daily - rinse thoroughly in fresh water and spray with WD-40 or equivalent. For long term storage - disassemble, clean out grease and water, regrease and reassemble.

INFORMATION SHEET 9-1-30I

TOOL: Diver Operated Pump

MANUFACTURER: ENERPAC

MODEL: P 80 (modified)

OUTPUT: High Pressure
3000-6000 psi,
low volume)

OUTPUT: High Pressure (3000 - 6000 psi, low volume)

SIZE: 20" x 30"

WEIGHT: 40 lobs in air

REMARKS: Basic configuration modified by addition of pliable bladder type pressure compensating reservoir. Power source can be used with a diversity of wire cutters, barstock cutters, jacks, pull cylinders, etc.

MAINTENANCE: Rinse with fresh water and spray with WD-40 or equivalent after use. Change oil weekly during active use, and change oil prior to long term storage.

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INFORMATION SHEET 9-1-31I

TOOL: Wire Rope Cutter SIZE: 12" long x 5" diameter

MANUFACTURER: H.K. Porter WEIGHT: 22 lbs

MODEL: HRC-118

INPUT: 3000-3500 psi

REMARKS: Used for wire rope up to 1/8" diameter powered by hand pump or intensifier.

CAUTION: Attempting to cut solid stock or re-bar will damage or destroy the cutter.

MAINTENANCE: Rinse with fresh water and spray tool with WD-40 or equivalent after use. Change oil once a week during periods of daily use or when long term storage is anticipated. Always store cutter fully extended.

INFORMATION SHEET 9-1-32I

TOOL: Barstock Cutter SIZE: 12" long x 12" wide

MANUFACTURER: H.K. Porter WEIGHT: 19.5 lbs

MODEL: 1770 MCK

INPUT: 3500 psi

REMARKS: Used for reinforcing bar up to 5/8" diameter and ACSR cable up to 1/2"

MAINTENANCE: Daily: Fresh water rinse and spray with WD-40 or equivalent. Store overnight with cutter jaws closed. Wipe cylinder clean and cover with light grease.
Long Term Storage: Disassemble completely, clean all parts, regrease and assemble, fill cylinder with fresh oil and keep piston extended.

INFORMATION SHEET 9-1-33I

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TOOL: Pull Cylinder

OUTPUT: Up to 6500 lbs

MANUFACTURER: Bruning

SIZE: 2" diameter x 20" long
10" stroke weight

MODEL: 4000 series

INPUT: Up to 5000 psi

ACCESSORIES: 1/2" alloy steel chain, hooks

REMARKS: Useful for pulling loads. Used two at a time to maintain tension in chain at all times.

MAINTENANCE: Rinse with fresh water. Spray with WD-40 or equivalent. Store with piston extended and covered with light grease.

INFORMATION SHEET 9-1-34I

TOOL: Jack

OUTPUT: Up to 5 tons lift

MANUFACTURER: ENERPAC

SIZE: 10" stroke

MODEL: RC 1010

WEIGHT: 13.5 lbs in water

INPUT: Up to 4500 psi

ACCESSORIES: Saddles, bases, extension tubes.

REMARKS: Useful for a variety of salvage tasks such as lifting, clamping, jacking, spreading.

MAINTENANCE: Rinse with fresh water, spray with WD-40 or equivalent. Store with piston extended and covered with light grease, PVC plastic pipe should also be inserted over the piston to protect during storage intervals.

INFORMATION SHEET 9-1-35I

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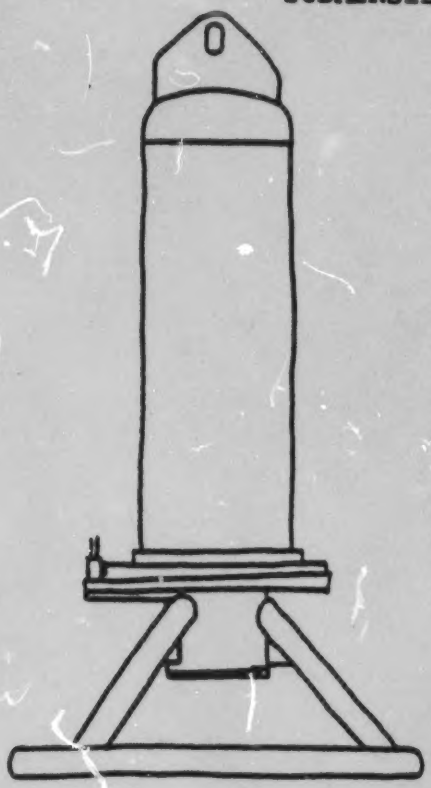
SUBMERSIBLE HYDRAULIC POWER



MANUFACTURER: SUB-TEK, INC.

MODEL: UPS - 14

ELECTRIC MOTOR: 7 1/2 hp Cont., 1800 rpm 220V-3Phase, 60Hz.(Other voltages available).

PUMP: 7 1/2 gpm, 1500 psi Continuous; 2000 psi intermittent; positive displacement Gerotor type.

OIL SYSTEM: Reservoir capacity 20 gallons. Standard compensator capacity 1/2 gallon.

WEIGHT: Approximately 850 lbs in air, inclusive of hydraulic fluid. Deck stand removable.

INFORMATION SHEET 9-1-36I

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POWER VELOCITY DRIVER (STUD GUN) FIRING PROCEDURES

Introduction

The following procedures will be adhered to at all times while working with the Power Velocity Driver. The instructor will stop any student who is not following safe firing practices.

FIRING PROCEDURES

1. Open barrel and check for obstructions. Use barrel cleaning rod (piston removing drift).

2. Select proper cartridge for the driver and job.

   a. Color coded

      (1) Yellow - 1/2" plywood to 1/4" steel, 1/2" wood to concrete, 1/8" metal to concrete.
      (2) Green - 1/4" steel to 1/4" steel, 1/2" plywood to 1/2" steel.

      (3) Red - 3/8" steel plate to 3/8" steel plate, 1/2" plywood to 5/8" steel plate.

      (4) Black - 1/2" steel to 1/2" steel.

3. Place cartridge in barrel.

4. Close barrel and pull barrel safety slide closed. Hold barrel closed.

5. Select proper area to fire stud.

   a. When patching underwater, it is recommended that a 3/16 to 1/4 inch thick rubber gasket be sandwiched between the patch plate and the vessel, and that studs be driven approximately 4 " apart. Edge distance should be at least 1".

   b. Use a centering disc when stud is to be driven into a pre-drilled hole. Place in the recess of the muzzle.

   c. Use a head washer in recess of muzzle if fastening thin or soft material to thicker or harder material.

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INFORMATION SHEET 9-1-37I

5. Barrel muzzle end must be held perpendicular to the work area. (Safety device: will not fire tilted over 8 degrees)

6. Push driver to work (must have a minimum down force of 5 lbs).

7. Pull trigger straight up into the handle (cocks and fires the driver).

SAFETY PRECAUTIONS

1. Never point a Velocity Power Driver, loaded or unloaded at anyone. Treat the tool as you would a gun.

2. Never load or fire without checking for obstructions in the barrel.

3. Select the proper cartridge for the material and the gun. If the shot is too heavy, it will go through the material.

4. Always check or know how/where the material is to be studded.

5. Never attempt to drive studs through:

   a. Tool or spring steel

   b. Brick, glass, glazed tile or other brittle material

   c. Any other material you can't positively identify

ASSIGNMENT SHEET 9-1-1A
TITLE: Underwater Tools

LESSON TOPIC OBJECTIVES

Terminal Objective
1. When the student completes this course, he will be able to, in an open tank, with at least eight feet of water, using the Mk 1 Mask and appropriate underwater tools, complete the following projects in accordance with Diving Training Standards: Three-Hole Flange, Drill and Tap, and Underwater Piling Saw (Hydraulic).

Enabling Objectives
1. Orally define/explain terms relative to the use of underwater tools.
2. Orally describe a surface supplied hydraulic set-up and the basic operation of selected underwater tools.
3. Orally describe how the underwater tools work with selected attachments.
4. Orally describe the special insulating and safety requirements for underwater electric tools and lights.
5. Orally describe loading and firing procedures and techniques for using the velocity power driver.
6. For the velocity power driver, pneumo-hydraulic grinder and drill:

   a. Orally explain the function(s) of each tool in terms of what they do for the system.
   b. Describe, in writing, the source(s) of power.
   c. Orally describe the modes of control.
   d. Orally list the protective devices and ratings of each tool.

7. Given a job analysis sheet on each project to be completed during this unit, orally explain the following aspects of each project:

   a. What the project is.
   b. Conditions under which the project is to be completed.
   c. Standards which will determine success.
   d. How to perform the project successfully.
   e. How each relates to a fleet diving job.
   f. Particular skills necessary for the successful completion of the project.

STUDY ASSIGNMENT

Student Guide Information Sheets 1 through 35, Underwater Tools

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ASSIGNMENT SHEET 9-1-2A

STUDY QUESTIONS

1. Why has the hydraulic umbilical system been found to have the greatest application to the U.S.Navy mission?

2. What are some of the personal diver safety hazards encountered with underwater power tools?

3. Why is an open-centered hydraulic system better for use in 40° water than using a closed-center system?

4. How do Electro-hydraulic Power Modules differ from Diesel Hydraulic Power Units?

5. Why is it advisable to use a hydraulic impact wrench rather than a hydraulic drill for drilling operations?

6. List the capacity, weight (in air) and depth capability for a 25 hp diesel hydraulic unit.

7. What is used to make fine adjustments in the rate-of-flow on the Model 1 Diesel Hydraulic Power Unit?

ASSIGNMENT SHEET 9-1-3A

8. Why is it necessary to maintain at least 100' of hydraulic line in the water when using the Model 1 Diesel Power Unit?

9. What oil is recommended for use (by NCEL) in the Model 1 Diesel Hydraulic Power Unit? Why? Does it meet the manufacturer's specifications? Why?

10. Under normal conditions, the pressure gauge should never exceed _____ psig.

11. Under normal conditions, the hydraulic temperature should never exceed _____F.

12. When breaking in a new or reconditioned engine, the load is applied in four steps. How much time should elapse between each step?

13. List the components of the Model 1 Diesel Hydraulic Power Unit battery charging circuit.

1.

2.

3.

14. Should grinding wheels, once used underwater, be used topside? Why?

15. Complete the following maintenance requirements for the Ackley Impact Wrench (3/4" Square Drive):

"Field strip forward portion (_____ section). Wipe clean and replace _____. Spray tool with _____ or equivalent and reassemble."

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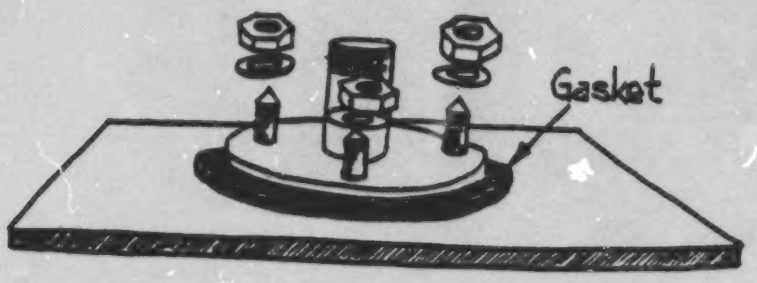
JOB SHEET 9-1-1J

TITLE: Underwater Tools Three-Hole Flange Project



INTRODUCTION

This project will use the largest combination of tools of any of the projects you will complete during this unit. You will be using the Velocity Power Driver (Stud Gun), wrench and grinder. It's important that you work as quickly and efficiently as possible but, remember to be exacting in vour work as well. One of the standards for success in this project is that you have an airtight seal when you're finished.

It is also important, very important, to remember that the Velocity Power Driver is a dangerous tool and must be handled accordingly. FOLLOW STRICT SAFETY PRECAUTIONS DURING THE TIME YOU ARE USING THIS TOOL.

REFERENCES

Diving Training Standards

EQUIPMENT AND MATERIALS

Swimming Trunks and Chafing Gear (or wet suits may be worn if the water temperature dictates), diving socks, Mk I Mask and associated equipment (including lightweight shoes and belt), 1/2" metal plate, Velocity Power Driver and studs, adjustable wrench, grinder, material for three-hole flange project.

JOB STEPS

1. Diver uses correct line-pull signals and descends to the bottom with center punch, hammer, velocity power driver, three hole template, gasket and the required nuts in a tool bag.

2. Diver places metal template on 1/2" metal plate and center punches for required three holes.

3. Put studs in place using the Velocity Power Driver (follow firing procedures)

a. Diver will request permission for each of the following steps:

(1) Loading
(2) Firing
(3) Checking Bore
(4) Reloading

4. Diver secures gasket and flange to the metal plate with the nuts and washers, tightening the nuts with an adjustable wrench.

5. Diver requests air hose from topside.

6. Diver secures air hose to flange.

a. Instructor will air test flange for leaks.

7. Diver removes air hose from the flange upon word from the instructor.

8. Diver removes flange and gasket from metal plate.

9. Diver requests grinder from topside.

10. Diver removes studs from metal plate with the grinder.

11. Diver sends grinder to the surface, gathers material and inserts it into the tool bag and, bringing it, comes to the surface.

SELF TEST ITEMS

1. Are you using correct line-pull signals and diving procedures?

2. Are you using correct firing and safety procedures for the Velocity Power Driver?

3. Are you firing the studs into the metal straight so that your seal between the flange and the plate will be airtight?

4. Are you working as quickly as possible?

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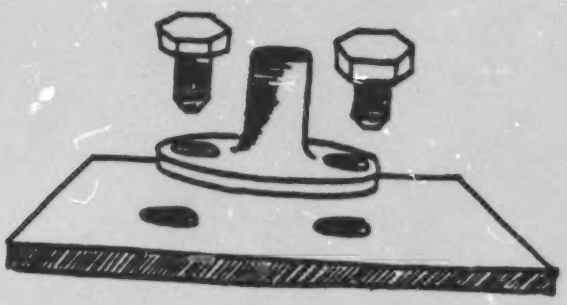
JOB SHEET 9-1-3J

TITLE: Underwater Tools Drill and Tap Project



INTRODUCTION

This project allows you to learn and experience another method of attaching one object to another underwater. This, too, requires a relatively large assortment of tools.

REFERENCES

Diving Training Standards

EQUIPMENT AND MATERIALS

Swimming trunks and chafing gear (or wet suits may be worn if the water temperature dictates), diving socks, Mk I Mask and associated equipment (including lightweight belt and shoes), 1/2" metal plate, hydraulic drill, tap and wrench, hammer, template and tool bag, hydraulic grinder.

JOB STEPS

1. Diver uses proper line-pull signals and descends to bottom with tool bag containing equipment used for project.

2. Diver places template on 1/2" metal plate and center punches for two holes.

3. Drill and tap holes.

4. Secure flange to metal plate with bolts.

5. Remove flange, replace bolts and request grinder from topside.

JOB SHEET 9-1-4J

6. Grind off bolts with the grinder.

7. Use proper line-pull signals, gather equipment and place in tool bag and, bringing it, return to the surface.

SELF TEST ITEMS

1. Are you keeping the drill at a 90° angle to the metal plate so that your holes will be straight?

2. Did you start the tap correctly so that your threads will be clean and straight?

3. Are you working a quickly and efficiently as possible?

4. Are you using correct line-pull signals and diving procedures?

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JOB SHEET 9-1-5J

TITLE: Underwater Tools Hydraulic Chain Saw Project

INTRODUCTION

Because of the sawdust created, and because the sawdust would be difficult to dispose of in an open tank, this project will be accomplished in semi-open water atmosphere. The project is valuable because you'll get the opportunity to use yet another hydraulic tool, the chain saw, and you'll have the experience of setting up/securing the Diesel Hydraulic Power Unit.

It is extremely important that you continuously think SAFETY during this project. The hydraulic chain saw, like it's top-side counterpart, is powerful and doesn't take a long time to cut a timber. It would be wise to take your time and not rush the saw through the timber so that you maintain control of the tool at all times. BE CAREFUL. YOU COULD VERY EASILY GET CUT.

REFERENCES

Diving Training Standards

EQUIPMENT AND MATERIALS

Swimming Trunks and Chafing Gear (or wet suits may be worn if the water temperature dictates), diving socks, MK 1 Mask and associated equipment (including lightweight belt and shoes), 12" x 12" timber, hydraulic chain saw, and grease pencil.

JOB STEPS

1. Diver uses proper line-pull signals and descends to the bottom.

2. Diver uses the grease pencil to draw a line on the timber approximately one inch from the end of the timber.

3. Diver uses proper line-pull signals to receive saw from topside.

4. Diver lines up chain saw with grease pencil line on the timber.

5. Press trigger on chain saw and begin cutting. CAUTION: Chain saw blade MUST be moving prior to engaging timber.

6. When timber slab floats free, release trigger and secure from the project.

7. Use proper line-pull signals and return the chain saw to the surface.

8. Use proper line-pull signals and return to the surface.

SELF TEST ITEMS

1. Are you taking your time, making a clean, straight cut, and being cautious?

2. Are you using proper line-pull signals and diving procedures?

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NOTETAKING SHEET 9-1-1N
TITLE: Underwater Tools

REFERENCES

U.S.Navy Diving Manual, Volume I
Naval Civil Engineering Laboratory Research Material
NAVSHIPS Technical Manual 0994-013-1010

NOTETAKING OUTLINE

A. Terms and Definitions

1. Hydraulic: operated by employing _____ or other type of _____.

2. Pneumatic: operated by _____.

3. Explosive Tool: an _____ device used in conjunction with an _____ to perform work.

4. Torque: that which tends to _____ _____.

5. Pump: an apparatus used for _____ a _____, or, as a verb, to _____ a _____.

6. Compressor: a machine by which _____ (or _____) is compressed so that its _____ may be utilized by a _____ of _____.

7. By-Pass: _____ _____ or _____.

B. Underwater Tools

1. Hand Tools

a. Screw Driver

(1) _____ is best type

(a) better _____

(b) better _____

(c) sometimes used with an _____ _____ for loosening or tightening.

b. Hammers

(1) Various sizes required - _____ than would be used on the surface for the same job.

(2) Various types used underwater

(a)

(b)

(c)

c. Rachet Wrench and Sockets

(1) Used for removing bolts on _____

(2) Quicker than an adjustable wrench.

d. Adjustable (Crescent) Wrench

(1) Tendency to _____ bolt heads.

(2) Sometimes used with a _____ _____.

e. Hack Saw

(1) Often works better with _____ pointed _____ the diver.

(2) Useful to have teeth ground on one side to _____ _____ _____.

f. Portable Hoists and Chain Falls

(1) Used for _____ _____ into place.

(2) Lowers heavy objects from the _____.

g. Allen Wrenches

h. Files

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NOTETAKING SHEET 9-1-3N

2. Pneumatic Tools

a. Best suited for _____ _____ work (less than _____)

b. _____ _____ driven.

c. Advantages

(1) _____ than equivalent electric tool.

(2) _____ than equivalent hydraulic tool.

(3) _____ through Government Supply System.

(4) Not harmed by rapid _____ or _____.

d. Disadvantages

(1)

(2) _____ _____ hamper visability

(3) Excessive _____ required.

(4) Required _____ and _____ (scfm) increase with _____.

e. Tools using rotating air motors:

(1) Drills:

(2) Impact Wrenches

(3) Chain and Circular Saws:

(4) Grinder:

(5) Hull Scrubber:

f. Tools using Reciprocating Pistons

(1) Chipping _____

(2) Saw

(a) Useful for cutting _____ or _____.

(3) Pavement Breakers and _____.

g. Use and Maintenance

(1) Tools with _____ _____ _____

(a) May fail to operate if _____ _____.

(b) _____ can sometimes be avoided through _____ _____.

(2) Tools with control valves on the exhaust side of the motor:

(a) are _____ over those with control valve on the _____ side.

(b) does not _____ when pressurized but not _____.

(c) few tools made this way.

(3) In-Line Oiler

(a) Should be used _____ _____ _____.

(b) Recommend _____-_____ oil.

(4) Storing Overnight

(a) Operate in a bucket of _____ _____ or _____ _____ and leave it in the _____.

(b) Swedish Navy: tools are left in the oil running slowly.

(5) Before placing in storage after use underwater:

(a) _____

(b) _____

(c) _____

(d) _____

(e) _____

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NOTETAKING SHEET 9-1-5N

h. Air Required

(1) Most require inlet pressure of _____ psig and _____ scfm on surface.

(2) Pressure at compressor (_____% variation allowable)

(3) Undersized compressor will not _____ _____ psig and allow the tool to work efficiently.

(a) _____ tank

(4) Fluid _____ increases with scfm and _____. Also increases as _____ _____ decreases.

3. Hydraulic Tools

a. Characteristics

(1) Tool _____ creates pressure.

(2) Tool _____ results from pressure supplied

(a) _____ = _____ force (measured in _____ _____)

(3) Tool speed results from _____ _____(_____)

(4) Friction losses become _____

(5) Hydraulic Power of Tool

$$HP = \frac{gpm \times psig}{1714}$$

(6) Friction Losses

(a) Hose size and psi available at the tool are not affected by having components _____.

(7) Hydraulic Fluids

(a) Thick (_____ viscosity) fluids are _____ for good lubrication and efficient _____/_____ operation.

(b) Thin (_____ viscosity) fluids minimize _____ _____ in components.

1. Do not mix different types of fluid.

(c) M.L.H.-5606B (Cherry Juice) or MIL24430

1. _____ hydraulic fluid.
2. _____ viscosity.
3. Tools _____-_____% efficient
4. _____

(d) Tool develops hydraulic pressure

1. Low pressure at tool and high pressure at pump - _____ _____ must be increased.

(8) Components needed for power source

(a) Reservoir: _____

(b) Temperature Gauge: records temperature of _____.

(c) Filter: protects _____ and _____

(d) Pump: _____ displacement, _____ type.

(e) Diesel Engine: _____ _____, _____ start.

(f) Relief Valve: Two - one set at _____ psig; one variable _____-_____ psig.

(g) Flow Controller: Controls flow to the _____; _____-_____ gpm.

(h) Pressure Gauge: Pressure in _____ _____ (before hose).

(i) Flow Meter: flow in hose to tool.

(9) Advantages

(a) _____ than equivalent electric or pneumatic tool.

(b) Not harmed by _____.

(c) Less affected by _____.

(d) No _____, little _____.

(e) Low _____ requirement.

(10) Disadvantages

(a) Not in Government Supply (FSN) System

(b) _____

(11) Open Center Hydraulic Tools: commercially available (usually require _____ _____).

(a) Impact Wrench

1. most useful

2. for bolts up to _____" diameter

3. also preferred for _____.

(b) Chain Saw

1. effective but _____

2. Piling Cut - safer if used with a _____ _____.

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(c) Grinder

1. Abrasive Saw attachments are too _____ for use underwater.

(d) Drill: not recommended as a _____ _____ because of the _____ when the drill bit binds.

(e) Sump Pump: when used with a pressure-balanced nozzle and fire hose, great _____ _____; produces _____ gpm. 325 gpm with 12 gpm on power source.

(f) Tamper: has not been evaluated underwater. May be useful as a large _____ and _____ driver.

(g) Hull Scrubber

(h) Cutters (wire, rope and pipe)

C. Units of Hydraulic Power Tools in Package: drawn from Emergency Ship Salvage Machinery (ESSM) Pool.

1. Stanley IWOC Impact Wrench

a. Designed for use underwater with impact _____ up to _____ with proper adapter.

b. Can be used for _____ holes up to _____ diameter.

c. Specifications:

(1) Chuck _____, quick change _____ drive, jacob's type 3B.

(2) Maximum chuck speed _____ rpm.

(3) Flow Rate to Tool _____ gpm.

(4) Operating Pressure _____-_____psig

(5) Weight _____ pounds

(6) Torque _____ ft. pounds

d. Nut Running

(1) Use _____ hex to _____ square adapter to incorporate standard impact sockets.

(2) Can be used in _____ or _____ for tightening/loosening bolts. 8 to 12 blows should be enough.

(a) CAUTION: Wrench will _____ heads and _____ threads in mild steel bolts if excessive _____ occurs.

e. Drilling and Tapping

(1) Same procedure as used _____.

(a) Drill _____ _____ first

(b) Follow with _____ drill.

1. Use _____ or high speed steel drill bits.

2. Do not allow drill to _____ as this will cause the drill bit edge to _____ _____.

3. Start drill to _____ before _____ metal surfaces to be drilled.

a. minimizes drill motor _____.

(c) Taps should be run in with short squeezes on the trigger, and without reversing direction.

1. Taps should be discarded after _____ uses as they will likely _____.

2. Prior to usage, taps should be _____ with _____-_____ _____.

f. Maintenance

(1) Daily

(a) _____ _____ with _____ _____

(b) Spray with _____

(2) Pre-Storage

(a) Remove _____ _____ and replace _____-_____ _____ on impact mechanism (never disassemble the impact hammer assembly).

(b) Grease the _____ _____ with water-resistent grease (_____).

(c) Reassemble and _____.

g. Prolonged use Underwater

(1) Never allow the tool to be left in contact with any _____ _____ as excessive and rapid _____ of the aluminum casing will occur.

2. Stanley IWI3 Impact Wrench

a. Designed for use underwater with impact sockets from _____-_____.

b. Used for _____ _____ and _____

c. Specifications:

(1) Maximum Speed _____rpm

(2) Flow Rate to Tool _____-_____gpm

(3) Operating Pressure _____-_____psig

(4) Impact Frequency _____ blows per minute.

(5) Weight _____ pounds

(6) Torque _____ ft. pounds.

d. Nut Running

(1) Uses _____ square drive impact sockets.

(a) Sockets held in place by piece of fiber or metal round stock retained in place by a rubber O-Ring.

(b) Very difficult to _____ _____ underwater.

e. Maintenance

(1) Same as Stanley IWOC Impact Wrench

3. Stanley IW060C Grinder

a. Designed for use underwater with grinding wheel, wire brush, abrasive skillsaw and secondary hull cleaner.

b. Specifications:

(1) Power Rating _____-_____hp

(2) Flow Rate to Tool _____-_____gpm

(3) Motor Speed _____ rpm

(4) Weight _____ pounds

(5) Maximum Grinding Wheel diameter _____.

(6) Shaft Size _____x_____ unc. threads.

c. Operating Procedures

(1) May be difficult to handle with a _____ _____ _____.

(a) _____ flow rate at hydraulic pump.

(b) Ideal flow rate produces _____ _____ of _____-_____ psig when grinder is rotating.

(c) Decreasing flow rate also decreases available _____ _____ at the tool.

d. Grinding Wheel

(1) Specially designed for use underwater.

(a) Abrasive grains _____ and _____ than on wheels used topside.

(b) Wheel sharpens itself by _____ individual grains to expose new sharp edges and by _____ off whole dull grains.

(c) Surface wheels can be used, but operations will be _____.

e. Maintenance

(1) Daily and Pre-Storage

(a) _____ _____ with fresh water and spray with _____.

f. Repair

(1) Seldom needs repair.

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(2) If unit does not operate:

(a) Check _____ _____ to insure mating and that hydraulic fluid is _____ to tool;

(b) If still doesn't operate, tool must be _____.

1. Refer to Manufacturer's Manual

4. Stanley Mod COSO70C Chain Saw

a. Designed for use underwater for cutting _____, _____ or _____ _____ structures.

b. Specifications:

(1) Cutting Capacity _____-_____inches

(2) Flow Rate to Tool _____ gpm

(3) Chain Speed _____-_____ fpm

(4) Operating Pressure _____-_____ psig

(5) Weight _____ pounds

(6) Automatic _____ and _____ _____ built in.

c. Operating Procedures

(1) As if you were operating topside.

d. Maintenance

(1) Daily and Pre-Storage

(a) Wash off with _____ _____ and spray with WD-40.

(2) _____ _____ on chain saw should be _____ with water-resistent grease after _____ operation.

5. ONAN Powered Hydraulic Pumping Unit

a. _____ cylinder _____ driving variable _____, variable _____ pump.

(1) Mounted on _____ _____ _____ assembly.

b. Preparation

(1) Refer to Information Sheet in Student Guide.

c. Starting Procedures

(1) Refer to Information Sheet in Student Guide

d. Shutdown Procedures

(1) Refer to Information Sheet in Student Guide

e. Operation: Setting Maximum Operating Pressure, Flow Rate and Changing Tools

(1) Refer to Information Sheet in Student Guide

D. Diver-Powered (hand-pump) Hydraulic Tools

1. Are suitable for _____ _____ or _____ only.

2. System is small, relatively _____ with a _____ work capability.

3. Cutters and jacks small enough to be handled by divers require small _____ (Less than a _____) of high pressure (_____-_____ psig) hydraulic fluid.

4. Components

a. Pump

(1) _____ and compensated _____ stores fluid.

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NOTETAKING SHEET 9-1-15N

(2) _____ pressurizes fluid.

(3) _____ _____ prevents return flow of fluid.

(4) check valve to guard against _____.

(5) _____ _____ allows fluid to return to reservoir.

b. Hose: conducts hydraulic fluid to tool.

c. Couplings: connect hose to _____ and _____.

d. Tool does the work; spring or load returns _____ to pump.

5. Best Power Source is a _____-_____ _____ pump.

a. Modified to pump on the _____ _____.

b. Pumps used below _____ _____ should have a pressure-compensated reservoir.

c. Pump can either be at the _____ _____ or on the _____.

6. Cutters

a. Wire Rope

b. Steel Bar

c. Copper/Aluminum Wire

7. Cylinders for Pusing/Pulling

8. Maintenance

a. Change oil (_____) regularly.
(MIL-H-6083C or MIL 24430)

b. Store jacks and cutters with cylinders extended to fill inside with _____; must protect _____ from damage.

E. HK Porter MOD HRC 118 Cable Cutter

1. Treated with a _____ _____ and Molybbdenum Disulfide coating to reduce _____.

2. Will not work with powered _____ _____.

a. Does not produce enough _____.

b. Does not allow cutter to _____ due to back pressure in the return hose.

c. Must be used with a diver-actuated _____ _____.

3. Operation

a. Range: _____-_____ psi

b. Connect cutter and hand pump on _____ with hydraulic hose _____ by pass valve on pump and allow cutter blade to _____.

c. Send pump and cutter down to diver.

d. Operate as required. Will accomodate up to _____ diameter _____ _____.

e. On return to surface:

(1) Extend _____ _____

(2) Let cutter blade _____ 1/4 to 1/2 inch.

(3) _____ pump

(4) Install plugged _____ _____ in female coupling on cutter.

(5) CAUTION: If above procedure is not followed, the life of the cutter will be drastically reduced.

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NOTETAKING SHEET 9-1-17N

4. Maintenance

a. After each use: Wash with _____ water and spray with _____.

b. If cutter is disassembled:

(1) Repack spring cavity _____full with _____ FSN 8030-251-3980

(2) Refill cutter with MIL-H-6083C or MIL24430 oil. _____.

c. Cutter blade is designed to have _____ flaton cutting edge. Do not _____ to a _____ _____.

F. HK Porter MOD 1770 MCK Bar Cutter

1. Capacity

a. 11/16" for _____ _____ and mild steel.

b. 1/2" diameter for _____ _____.

2. Operational Procedures

a. Same as for the cable cutter.

G. ENERPAC RC 106 and RC 1010 10 Ton Jacks and BU 300A 5 Ton Self Contained Jack

1. RC 106

a. Rated Capacity _____ tons

b. Hydraulic Pressure Applied _____ psi

c. Plunger Stroke _____ inches

2. RC 1010

a. Rated Capacity _____ tons

b. Hydraulic Pressure Applied _____ psi

c. Plunger Stroke _____ inches

3. BU 300A

a. Rated Capacity _____ tons

b. Plunger Stroke _____ inches

c. Diver _____

d. _____ _____

4. All rams use MIL-H-6083-C oil or MIL 24430 oil.

5. Various attachments can be used with rams:

a. all rated _____ tons

b. Made of special _____ steels

6. Maintenance

a. Wash off with fresh water

b. Spray any exposed threads with _____

c. Spray unit with _____

H. Diver-Operated Hydraulic Pump ENERPAC MOD P-80-2

1. Modified Commercial Pump

a. Pumps on _____

2. Can be operated at job site, by diver, or on the surface.

a. has _____ lead hose for underwater use

b. has _____ _____ compensator built in.

c. Use _____ lead hose for topside operation

(1) Takes _____ as many strokes due to _____ of _____ of 100 ft lead hose.

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NOTETAKING SHEET 9-1-19N

3. Installed on aluminum base. Old type has knee rests and toe holds. Newer types have a different handle allowing upright operation.

I. Hydraulic Pulling Cylinder Bruning MOD 4000

1. Rated at _____ tons

2. Supplied with 10 ft of special alloy _____ _____.

a. by moving _____ _____ after each retraction, it is possible to move _____ _____/_____ stroke.

3. Depth limit _____ feet due to air pressure in _____.

a. Used to extend _____ _____ after retraction.

b. Maintain charge at _____-_____ psig

c. _____ type tire valve

4. Maintenance (after use)

a. Wash off with fresh water

b. Make sure cylinder rod is _____

c. Spray with WD-40

J. Electric Tools

1. Limited number available for use underwater

a. Several 5/8 hp tools with adapters for drilling, impacting, grinding and hole sawing have been developed.

b. Underwater _____ _____ are often used for photography and inspections.

c. _____ _____

d. Underwater electric _____ _____ and _____ equipment.

e. Submersible Electrohydraulic Power Sources.

2. Shock Hazard

a. _____ kills

(1) Low Voltage systems are safer because the _____ is less likely to break down.

(2) If there is an insulation defect, a _____ volt DC system is as deadly as a _____ volt three phase system.

b. Safety Circuit Breakers (_____ _____ detectors)

(1) Device should interrupt the current in _____msec in case of a short or at a _____ma if the insulation is slowly deteriorating.

(2) _____ _____ for 110VAC equipment.

(3) A SAFETY DEVICE FOR 3 PHASE AC UNDERWATER DEVICES IS NOT COMMERCIALLY AVAILABLE.

(4) A SAFETY DEVICE FOR DC EQUIPMENT IS NOT AVAILABLE.

c. The chance of a diver receiving a paralyzing or lethal shock can be reduced by not placing his _____ or his _____ between the _____ _____ and the _____ (usually the _____ or _____)

K. Power Actuated Projectile Unit (Stud Gun)

1. Two Models Approved for Navy Use:

a. MK 24 or Mk 26 MOD 0 Kit

(1) _____ duty

(2) _____ types _____ diameter studs

(3) Can be used to _____ feet

NOTETAKING SHEET 9-1-21N

(4) Operated in _____ _____

(5) To be fired underwater, it must be _____ _____.

b. Mk 25 or Mk 27 MOD 0 Kit

(1) _____ duty

(2) _____ types of _____-_____ studs

(3) Can be used to _____ feet

(4) Operated in ___ _____ position

(5) Has _____ detachable _____.

(6) Loaded _____ only

(7) Barrels may be connected to the drive unit _____.

2. Several power velocity drivers are commercially available. Most are designed to install a 3/8" diameter or smaller stud. These are normally limited to 100 feet or less.

3. Use

a. Fast method of installing _____.

b. Pullout strengths of a single stud have averaged _____ of manufacturer's rating.

c. Using two may not be stronger than using one to hold padeyes or patches. Firing vibration tends to loosen previously driven studs.

d. Studs are normally very _____.

e. Normally, _____ of the studs fail to fire.

f. Completely _____ and clean prior to _____.

4. Operating Procedures

a. Refer to Student Guides

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FOR OFFICIAL USE ONLY

STUDENT GUIDE

FOR

DIVER, SECOND CLASS (A-433-0022)

SHIP SALVAGE DIVING OFFICER (A-4[illegible]-0011)

DEEP SEA (HeO2) DIVING OFFICER (A-[illegible]-0010)

VOLUME J

Underwater Cutting and Welding

PREPARED BY

NAVAL SCHOOL DIVING AND SALVAGE

PREPARED FOR

SERVSCOLCOM, SDIEGO

SUBTRACENPAC, PHARBOR

NAVSCOLDIVSAL, WASH

31 OCTOBER 1975

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INFORMATION SHEET 10-1-1I

TITLE: Underwater Cutting and Welding

INTRODUCTION

Cutting and welding are important skills to develop for surface repairs as well as underwater work. As you read through the Underwater Cutting and Welding Technical Manual (NAVSHIPS 0029-0008010), you will see example after example of how cutting and welding have been used in diving operations.

Unfortunately, there will not be sufficient time within this unit to provide you with enough instruction and experience to classify you as a competent welder. We do, however, introduce you to a variety of cutting and welding techniques used in underwater work. You will also have the opportunity to practice each of these techniques, although this too is limited by time. Familiarization with the techniques plus experience in your fleet diving job will make you a competent welder.

Perhaps the most important aspect of cutting and welding is safety and, during this unit, you will hear it stressed again and again. Safety will be taken into account during your completion of the projects for this unit. If you are in violation of safety rules you will be (at the least) stopped and reminded and, if the violation is serious enough (or too frequent) you will terminate the project. This is not harrassment--THIS IS FOR YOUR PROTECTION! The best advice is for you to read, remember and PRACTICE the rules of safety for underwater cutting and welding.

ASSIGNMENT SHEET 10-1-1A

TITLE: Underwater Cutting and Welding

LESSON TOPIC OBJECTIVES

Terminal Objectives

1. When the student completes this course he will be able to, in an open tank with at least eight feet of water, using the Mk V Deep Sea Diving System, successfully complete any three of the following projects in accordance with Diving Training Standards: Oxygen-Arc Cutting (Ceramic Rod), Oxygen-Arc Cutting (Steel Tubular Rod), Shielded Metal Arc Cutting, Shielded Metal Arc Welding.

Enabling Objectives

1. Define/Explain, in writing, terms relative to underwater cutting and welding.
2. Orally describe the types of cutting and welding that will be used in completion of the projects during this unit.
3. Describe, in writing, the various materials used in underwater cutting and welding.
4. Orally explain the function(s) of the various methods of underwater cutting and welding used in completion of the projects for this unit.
5. For each of the types of underwater cutting and welding used in completion of the projects during this unit:
    a. Explain, in writing, the function(s) of the component parts in terms of what they do for the individual components.
    b. Describe, by illustration, the physical location of the component parts within each of the major components.
    c. Orally explain how the component parts carry out their function(s).
    d. List, in writing, the ratings and specifications of selected component parts.
    e. Describe, by illustration, the source(s) of power for selected component parts.
    f. Orally describe the protection provided the system by applicable component parts.
    g. Describe, in writing, the major materials used in construction of selected component parts, and explain why the particular materials are used.
6. Describe, in writing, the important features used to complete the projects of this unit.
7. Orally describe the procedures for determining the polarity of a welding generator if polarity markings are illegible.
8. Orally explain a simple schematic diagram of a typical arrangement for oxygen arc cutting.
9. Orally explain the preparation of an emergency tubular electrode.

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ASSIGNMENT SHEET 10-1-2A

10. Describe, in writing, the advantages of steel tubular electrodes versus the advantages of ceramic tubular electrodes.
11. Orally describe cutting techniques for oxygen arc for thick and thin steel plate using the steel tubular electrodes.
12. Describe, in writing, the principle of operation for shielded metal arc cutting.
13. Describe, in writing, the proper metallic arc cutting technique for steel plate less than 1/4 inches thick.
14. Explain, in writing, the advantages of oxygen hydrogen cutting.
15. Orally explain why hydrogen and not acetylene is used as a fuel gas.
16. Describe, in writing, the principle of operation in oxygen hydrogen cutting.
17. Explain, orally and in writing, procedure for lighting the oxygen hydrogen torch underwater.
18. Explain, orally and in writing, the techniques for starting and advancing the cut with an oxygen hydrogen torch.
19. Describe, in writing, the principle of operation for shielded metal arc welding.
20. Describe, in writing, the largest diameter electrode recommended for shielded metal arc welding operations.
21. Describe and demonstrate the preparation of an underwater surface for welding.
22. Describe, orally and in writing, the importance of the welding current setting.
23. State, in writing, the set point(s) in terms of operating above or below them for:
    a. Figuring correct gas pressure at depth.
    b. Polarity.
24. Describe, in writing, and demonstrate safety precautions unique to underwater cutting and welding:
    a. Trapped explosive gases.
    b. Placing the diver between the ground and electrode.
25. Given a job analysis sheet for each project to be completed during this unit, orally explain the following aspects of the project:
    a. What the project is.
    b. The conditions under which the project will be completed.
    c. Standards which will determine success.
    d. How to perform the project successfully.
    e. How each project relates to a fleet diving job.
    f. Particular skills necessary for the successful completion of the project.
26. In an open tank with at least eight feet of water, using the Mk V Deep Sea Diving System, practice each of

ASSIGNMENT SHEET 10-1-3A

the underwater cutting methods used in completion of the projects for this unit. As many as three electrodes (one ceramic) may be used for practice (determined by the student).

DAY 1 STUDY ASSIGNMENT

NAVSHIPS 0929-000-8010, Section I; Section III, Part 1; Section IV, Part 1; Section V, Part 1; Section VI, Part 1; Section VII; Section VIII; Glossary.

STUDY QUESTIONS

1. What are the factors that make underwater cutting and welding difficult?

a.

b.

c.

d.

e.

f.

2. Which is the most popular and preferred method of underwater cutting?

3. Why is shielded metal-arc cutting the best method to use for cutting stainless steel?

4. To cut, it is essential that both sides of the material be thoroughly cleaned.

a. True

b. False

5. Match the cutting method with one of its advantages:

___1. No pre-heat time necessary.

___2. Can be used to cut some nonmetallic objects.

a. Oxygen-Hydrogen

b. Oxygen-Arc

c. Shielded Metal-Arc

ASSIGNMENT SHEET 10-1-4A

____3. Skipped areas and slag can be easily cut.

____4. No source of fuel gas, oxygen, or air required.

____5. Torch is light and easy to handle.

____6. No danger existing due to electrical shock.

6. Why is welding important in underwater work?

7. Define Oxygen-Arc cutting.

8. The electric arc in shielded metal-arc cutting, will produce temperatures in range of about _____ to _____ F depending on: _____ _____.

9. What function is performed by the shielding cup in oxy-hydrogen cutting operations?

10. Complete the following:

_____ injury or _____ may result when adequate _____ are not followed in underwater cutting and welding operations. Personnel in _____ of such operations and their _____ shall be thoroughly familiar with all of the _____ _____ given in Section _____ of this manual. All concerned shall be

ASSIGNMENT SHEET 10-1-5A

constantly on guard for _____ not _____

by this manual.

11. What are two other names for Underwater Shielded Metal-Arc Welding?

12. In what situation would you use Oxy-Napp gas cutting method for a fleet diving job? Why?

13. Define the following:

a. Cutting Tip:

b. Kerf:

c. Spatter:

d. Undercut:

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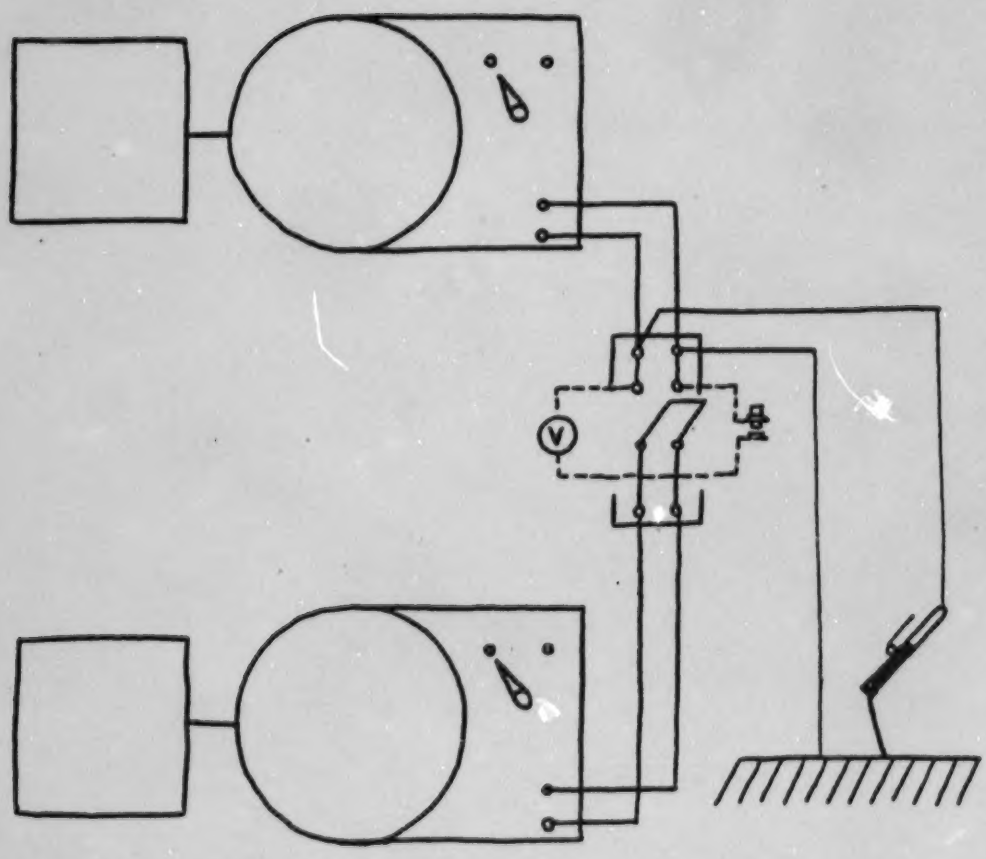
ASSIGNMENT SHEET 10-1-6A

14. The drawing below illustrates the connections for paralleling variable voltage D-C Generators. Label the components. When would this procedure be used?



ASSIGNMENT SHEET 10-1-7A

DAY 2 ASSIGNMENT

NAVSHIPS 0929-000-8010, Section II.

STUDY QUESTIONS

1. Who may engage in underwater cutting and welding operations?

2. Complete the following: "The only safe way to handle any electric circuit is _____ _____ _____."

3. Under what circumstances could a standard electrode holder approved for topside use be used for underwater work?

4. What is the minimum distance from the electrode holder that Navy-approved splice-free cable must be used?

5. How is full protection obtained in the use of the positive-operating safety switch?

6. After completing a cutting operation, the diver signals, "Current Off." Answer the following questions about this situation:

   a. When does the tender repeat the given signal?

   b. When does the diver lift the electrode from his work?

7. How can it be insured that a single-pole switch is not being shunted out?

689 ASSIGNMENT SHEET 10-1-8A

8. How should you test an oxy-hydrogen piping system for leaks? What should never be used?

9. What should be accomplished before using an igniter?

10. What additional precautions in diver dress/equipment are taken for cutting and welding operations?

11. In what circumstances could a lighted oxy-hydrogen torch be lowered to the diver?

12. How can you be sure that a compartment being cut into does not contain explosive gases?

13. Having read the section of Underwater Cutting and Welding Safety, write a general rule stating the most important precautions for personnel and equipment.

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ASSIGNMENT SHEET 10-1-9A

SAY 3 ASSIGNMENT

NAVSHIPS 0929-000-8010, Section III

STUDY QUESTIONS

1. Why are A-C Welding Power Supplies not recommended for underwater oxygen-arc cutting?

a.

b.

c.

2. What is the advantage of using 2/0 cable for underwater oxygen arc cutting?

3. Describe the bubble indication when determining the polarity of a welding generator.

Bubbles will flow:

Bubbles will not flow:

The polarity is correct if:

4. What two steps can be taken to increase the life of welding cable not in use?

a.

b.

5. What are the major disadvantages of ceramic-tubular electrodes?

a.

b.

ASSIGNMENT SHEET 10-1-10A

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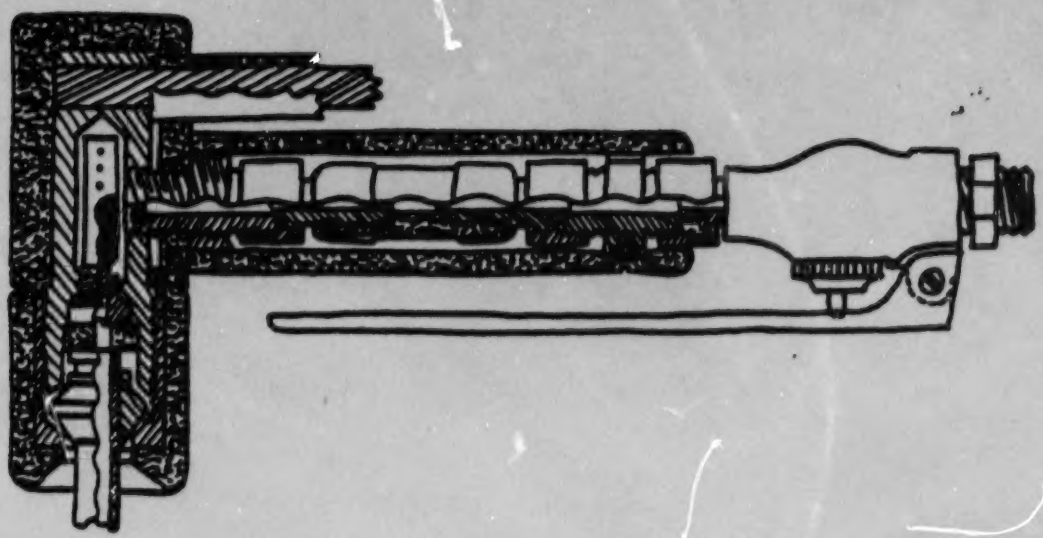

6. Label the picture above with the major components of the underwater oxygen-Arc cutting torch and, below, describe the function of the components.

a. Oxygen Valve

b. Electrode Grip

c. Insulator Coupling

d. Flashback Arrester

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ASSIGNMENT SHEET 10-1-11A

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7. Describe a "Swafford" electrode.

8. What is the percentage ratio of reduction in cutting speed to decrease in oxygen purity?

9. What is meant by "backflare?"

10. What are the major technique differences between oxygen-arc cutting with steel tubular and ceramic tubular electrodes?

a.

b.

11. What is the maximum current usage recommended for oxygen-arc cutting operations for cast iron and non-ferrous metals?

12. What would be the regulator pressure necessary for operations at 150 feet, cutting 1/2" plate?

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ASSIGNMENT SHEET 10-1-12A

DAY 4 ASSIGNMENT

NAVSHIPS 0929-000-8010, Sections IV & V

STUDY QUESTIONS

1. What advantage would using a 400 amp d-c welding power supply for metal-arc cutting instead of a 300 amp power supply?

2. Contact resistence can be kept to a minimum by:

3. Of the following statements regarding Shielded Metal-Arc Electrodes, circle the letter of those that are true.
   a. Waterproofing electrodes prior to use underwater is necessary to protect the arc.
   b. Dipping electrodes in shellac is often a satisfactory waterproofing technique.
   c. The number of dips depends upon the depth at which the electrode will be used.
   d. After dipping, excess coatings should be applied to the tip to facilitate starting the arc.

4. How many electrodes would be required to cut 3 feet of 1/2" plate using 1/4" electrodes?

5. Shielded Metal-Arc Cutting is a (1) oxidation (2) melting (3) consumed metal process.

6. What governs the operating efficiency of gauges, regulators. hoses and torches?

7. For the underwater oxy-hydrogen cutting torch, what function is performed by:

   a. The outer envelope of compressed air:

   b. The preheat flame:

   c. The central oxygen jet:

ASSIGNMENT SHEET 10-1-13A

8. It is preferred that the underwater oxy-hydrogen cutting torch be ignited topside.

a. True

b. False

9. "Never lower as ignited torch until it is certain that the _____ is _____ and _____ for it and is in the clear in such a position that the _____ _____ cannot possibly strike his _____, _____, or _____ _____."

10. Complete the following:

Working Depth	Approximate PSI	Length of	Gauge Pressures, PSI		
Feet	Water Pressure	Hose, Feet	Air	Hydrogen	Oxygen
10	_____	100	55	55	____
60	26	_____	___	90	110
125	54	_____	___	_____	____

11. When igniting the oxy-hydrogen cutting torch underwater, and all preparations have been made, the diver operates the igniter but the torch does not light. What is his next step?

12. For proper adjustment of the oxy-hydrogen cutting torch, what should the length of the oxygen bubble be? The compressed air bubble?

13. What are the indications for:

a. Oxygen too high:

b. Compressed air too low:

14. It is possible, using a small horseshoe magnet underwater, to distinguish steel, wrought iron.

a. True

b False

NOTE: ASSIGNMENT SHEET 10-1-14A HAS BEEN DELETED; HOWEVER ALL MATERIAL IS INCLUDED.

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ASSIGNMENT SHEET 10-1-15A

DAY 5 ASSIGNMENT

NAVSHIPS 0929-000-8010, Section VI

STUDY QUESTIONS

1. Write one general safety rule regarding the operation of the safety switch which would be applicable in all cutting and welding operations.

2. For the following factors, write general rules regarding cable used in cutting and welding operations:

   a. Length of cable:

   b. Connectors:

   c. Life of a cable:

3. What brands of electrodes are currently recommended for underwater welding in all positions? Are they specifically for underwater use only?

4. What effects are noticed when using Underwater Shielded Metal-arc Welding electrodes and reverse-polarity direct current?

5. What are the five adverse conditions under which underwater welding is difficult or impossible?

   a.

   b.

   c.

   d.

   e.

6. What was found in tests comparing the 3/16" electrode to the 5/32" electrode?

7. When would a 5/32" electrode be preferred over a 3/16" electrode?

8. List the current setting and time for a 12" burnoff, using a Westinghouse Flexarc SW, 3/16" electrode, in an overhead position.

a. Current:

b. Time:

9. How much weld metal is deposited for 10 inches of electrode consumed?

10. Is it better to weld toward yourself (the diver) or away from yourself? Why?

11. In overhead welding, dripping beads indicate:

a.

b.

c.

12. Regarding patching: "The safest rule to follow is to use a _____ where practicable and when that is impractical, to apply a patch _____ with _____ and then _____ to insure greater _____."

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JOB SHEET 10-1-1J

TITLE: Underwater Cutting and Welding

INTRODUCTION

In the completion of the projects for this unit, keep in mind all the rules of diving you have learned thus far in your training--work efficiently and effectively; use line-pull signals and voice communications correctly. In cutting and welding operations, however, it is necessary that safety be stressed and stressed again. Having read the rules of safety in the Cutting and Welding Technical Manual, FOLLOW THEM! Your adherence to these safety rules will be a part of the determination of whether you have performed satisfactorily or not, but, you should follow them for your own well being.

REFERENCES

Diving Training Standards NAVSHIPS 0929-000-8010

Equipment and Material

Diving Underwear and socks, Mk V Deep Sea Diving System, Oxy-Arc Cutting Torch and Power Supply, Ceramic/Steel Tubular Electrodes, Tool Bag, Crescent Wrench, Wire Brush, Chipping Hammer and Steel Plate (3/8" to 3/4" plate).

JOB SHEET 10-1-2J

JOB STEPS

1. Oxy-Arc Cutting (Ceramic)

a. Diver uses proper line-pull signals and descends to bottom of open tank, carrying tool bag, crescent wrench, wire brush and electrodes.

b. Position project plate on work bench with C-clamp.

c. Attach ground clamp to project plate.

d. Request electrode holder from topside.

e. Clean area of project plate where cut is to be made with the wire brush.

f. Insert the electrode into electrode holder.

g. Place electrode on the project plate at the location where the cut is to be made.

h. Close supplementary face plate.

i. Squeeze oxygen trigger.

j. Call for "Switch on."

k. Make the cut.

l. Call for "Switch off."

m. Secure electrode holder from cutting position.

n. Request topside retrieve electrode holder.

o. Put tools, cut project plate in tool bag, use proper signals and return to the surface.

2. Oxy-Arc Cutting (Steel Tubular)

a. Steps to be completed are as described above.

3. Metallic-Arc Cutting (Shielded)

a. Complete steps 1a through 1k, above.

b. To stop cutting process, lift the electrode away from the project plate.
(1) Leave a minimum of 3 inches of electrode not consumed to avoid damaging the electrode holder.

c. When cut is complete, call for "Switch off."

d. Request topside retrieve the electrode holder.

e. Put tools, cut project plate in tool bag, use proper signals and return to the surface.

4. Shielded Metal Arc Welding

a. Diver uses proper line-pull signals and descends to bottom of open tank, carrying tool bag, wire brush, chipping hammer, crescent wrench and electrodes.

b. Position 6" X 6" project plate in clamping device at 45°.

c. Install grounding clamp on project plate.

d. Request electrode holder from topside.

e. Diver positions himself in welding position. Insert electrode into electrode holder.
(1) CAUTION: Do not touch any part of diving outfit with the electrode.

f. Diver places electrode on steel project plate in position of desired weld and closes supplementary face plate.

g. Call for "Switch on."

h. Make weld across the plate.

i. Call for "Switch off."

j. Use a wire brush to clean the weld and then inspect it.

k. Using steps 4e through 4j, make a second weld at 90° of the first weld in such a manner as to pass over the first weld.

l. Make a third weld as above except that the weld must pass over intersections of weld 1 and 2. CAUTION: Diver

should leave a minimum of 3" of electrode not consumed to prevent damage to the electrode holder.

m. Turn project plate over and center 4"X4" plate on 6"X6" plate and clamp them together.

n. Change electrodes.

o. Make first weld--top to bottom on one side.

p. Make second weld--top to bottom on remaining side.

q. Using new electrodes for each weld, make passes three and four.

r. Reinforce each corner as in practice step 4L, above.

s. Remove welded plates from clamping device, secure in tool bag.

t. Request topside retrieve electrode holder.

u. Using proper signals, carry tools and tool bag (with welded project) to the surface.

701 JOB SHEET 10-1-5J

SPECIAL INSTRUCTIONS

1. Ceramic Electrode

a. You get one (1) electrode for use in practice and project work. One inch may be used for practice and any of the required cuts should take no more than one inch.

b. You may use the crescent wrench to help separate the cut plate from the main plate.

2. Steel Tubular Electrode and Metallic-Arc Cutting

a. You may have as many as three electrodes for practice, if necessary. You will determine how many. For example, you may practice with one electrode, feel you have the technique correct and are ready to make a cut for score.

b. Only one electrode will be used for the graded cut.

c. You may use the crescent wrench to help separate the cut plate from the main plate.

3. Welding Project

a. Student gets one (1) practice electrode.

b. Once the project plates are clamped into position, they must not be moved until the project is complete!

NOTETAKING SHEET 10-1-1N
TITLE: Underwater Cutting and Welding

REFERENCES

U.S. Navy Diving Manual, Volume I NAVSHIPS 0929-000-8010

NOTETAKING OUTLINE

A. Terms Relative to Underwater Cutting and Welding

1. Arc--A _____ circuit between the _____ and the _____.

2. Ground--_____ pole on welding machine.

3. Connectors--A means of connecting two _____ _____ (____') together.

4. Ignite--Producing sufficient _____ to _____ a torch.

5. Shielded--Cutting using _____ type _____.

6. Polarity--_____ of current flow, straight polarity is from _____ to _____.

7. Switch on/off--The position of the _____ _____ giving the diver power to the electrode _____.

8. Water Proofing--To protect the covering from _____ _____ by seawater.

9. Cut/burn off ratio--_____ linear inch of metal _____ per inch of electrode _____.

10. Flashback--A recession of the _____ into or back of the mixing _____ of the _____.

11. Kerf--The _____ from which the metal has been _____ by a _____ process.

12. Supplementary Faceplate - Added to existing diving helmet faceplate to prevent damage to diver's eyes.

703 NOTETAKING SHEET 10-1-2N

B. Oxygen-Hydrogen Cutting

1. Classified as _____ cutting process.

2. Rapid _____ or rusting.

3. Metal brought to _____ temperature with O2 & Hydrogen.

4. Jet of pure _____ directed at heated area _____ metal rapidly.

5. Cutting Torch

a. Type

(1) _____, Harris 28, AirCo, _____.

b. Construction

(1) _____ knob.

(2) _____ knob.

(3) _____ _____ knob.

(4) _____ chamber.

(5) Air _____.

(6) Distance Shoe _____".

c. Tips

(1) Size depends on _____ of _____ being cut.

(2) Not _____.

6. Hoses

a. Oxygen Hose

(1) Color: _____.

(2) Size _____ ID, _____" OD.

(3) Not for use on _____.

(4) _____ hand threads.

b. Air Hose

(1) Color: _____.

(2) Size: _____" ID, _____" OD.

(3) Not for use on _____.

(4) _____ hand threads.

c. Hydrogen Hose

(1) Color: _____.

(2) Size: _____.

(3) _____ hand threads, _____.

7. Regulators

a. Oxygen Regulators

(1) _____ _____--hand controlled.

(2) 0--_____ HP; 0--_____ LP.

(3) Used to _____ bottle _____ to desired pressure.

(4) _____ hand thread.

(5) Use for _____ only.

b. Air Regulator

(1) Same as _____ regulator.

(2) Not for use for _____.

c. Hydrogen Regulator

(1) _____ stage--_____ controlled.

(2) 0--_____ HP; 0--_____ LP.

(3) To reduce bottle pressure to desired pressure.

(4) _____ hand threads.

(5) _____ fitting.

8. Igniter

a. Electrical

(1) Preferred method of lighting oxy-hydrogen _____ _____.

(2) Power Supply: _____ volts

(3) Must have _____.

(4) Spark through to _____ contacts.

(5) Must be dressed in _____ _____ _____ before using.

b. Friction Lighter

(1) For lighting torch _____.

(2) Same as one used for lighting Acetylene Torch.

9. Oxygen-Hydrogen Torch

a. Advantages

(1) _____ _____ is not necessary.

(2) _____ _____ equipment can be used.

(3) _____ _____ can be used because equipment is portable.

(4) Can cut _____ or _____ easily.

b. Disadvantages

(1) Hydrogen is and undersireable _____ _____.

(2) Non-ferrous metals not readily oxidized.

10. Oxygen-hydrogen Torch

a. Acetylene

(1) Underwater use: _____ only.

(2) Considered unsafe at pressure above ___ psi.

11. Principle of Operation

a. Cutting metal by means of the _____ _____ of O2 with the metal at _____ temperature.

b. Temperature maintained by means of _____ _____ obtained from combustion of hydrogen and O2.

c. Preheat maintained by a _____ of _____ from torch.

d. Lighting under water:

(1) Open _____ to a _____ bubble, note setting then _____.

(2) Open _____ to a _____ bubble, note setting then secure.

(3) Open _____ to a _____ bubble, _____ _____.

(4) Open air and hydrogen to _____ _____.

(5) Light with _____ igniter.

(6) If torch is moved more than 20', it must be _____.

e. Starting Cut and Advancing

(1) Insure _____ _____.

(2) Place _____ _____ on metal to be cut.

(3) Hold torch in one place to _____ _____.

(4) Press _____ trigger.

(5) Pull torch along _____ _____ of cut.

f. Safety Precautions

(1) _____ compartment and adjacent _____.

(a) _____ off gases.

(b) _____ _____ in top of compartment.

(2) Gases Encountered

(a) _____.

(b) _____.

(c) _____.

(d) _____.

(e) _____.

(f) _____ _____.

(3) _____ _____ of metal being cut.

(4) _____ from electric igniter.

C. Oxygen-Arc Cutting

1. Process

a. Rapid oxidation or _____.

b. Arc maintained by a _____ _____ _____ electric current.

c. _____ forced through _____ in _____ to cut metal.

2. Navy Standard Cutting Electrode Holder

a. Nomenclature

(1) #200 modified _____ _____ valve.

(2) _____ trigger.

(3) Made of _____ ID _____ fittings.

(4) _____ assembly.

(5) Insert for _____ _____.

b. Function

(1) Designed to _____ electrode.

(2) Delivers _____ to electrode.

c. Safety precautions

(1) Must be completely _____.

(2) Power to _____ _____.

(3) Only one _____ for underwater work can be _____.

(4) Do not use _____ type.

(5) Inspection of the electrode holder should be made _____ to _____ _____.

(6) Never _____ the electrode so that is will be _____ _____ the diver.

(7) Never get _____ the _____ _____ and the _____.

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(8) Never change _____ in the holder when the _____ is _____.

3. Electrodes

a. Steel Tubular Cutting

(1) Steel Tube _____ long X _____ diameter with _____ bore.

(2) Waterproof _____ covering

(a) _____ _____ waterproofing

(b) Other Types.

(3) Steel tubes used because of _____ _____ _____.

(4) Purpose of Flux

(a) Promotes easy _____ and _____ of the _____.

(b) Forms and maintains a _____ _____ around the arc.

(c) Serves as an electric _____.

(d) Prevents arcing from the _____ of the electrode.

(e) Waterproofed by manufacturer by _____ them in a _____ lacquer.

(6) Advantages

(a) _____ technique.

(b) Ease of operation for _____ _____ of metal being cut.

(c) _____ _____ of cutting.

(d) _____ and _____ cut.

(e) _____ _____ is within a 300 amp welding generator.

(7) Technique

(a) _____ electrode in holder firmly against _____ _____.

(b) Make a _____ _____.

(c) Hold electrode _____ to surface to be cut.

(d) Use a _____ motion.

(e) For non-ferrous metals over 1/4" thick, use a _____ motion.

(f) Pressure exerted:

1. Down to compensate for _____.

2. Forward to _____ the cut.

(g) For metal over 1/4" thick, hold electrode at _____°.

(h) For metal under 1/4" thick, hold electrode at _____°.

(i) Use _____ instead of _____ when cutting non-ferrous metals.

(8) Emergency Use

(a) _____ heavy walled steel tube.

(b) _____ extra strong _____ pipe.

(c) Both will be _____ long.

(d) Cover complete rod except end that _____ in electrode _____.

1. _____ wraps of _____ _____, or
2. _____ wraps of _____, or
3. _____ wraps of _____ paper, or
4. _____ wraps of _____ paper.

(e) Same _____ _____ and _____ _____ is used.

b. Ceramic Tubular Cutting

(1) _____ carbide tip.

(a) _____ diameter X _____ long, with _____ bore.

(b) _____ _____ sheath sprayed on.

(c) Electrical sleeve _____ with _____ material.

(d) One end ground to _____ diameter for electrode holder.

(2) Advantages

(a) Long _____ due to _____ _____ rate.

(b) Length allows to work in _____ _____.

(c) _____ _____.

(d) Service life _____ to _____ minutes.

(3) Disadvantages

(a) _____ and easily _____.

(b) _____.

(4) Technique

(a) Same as steel tubular

(b) Do not apply a lot of _____ to _____.

c. Shielded Metal Arc Cutting

(1) A method of metal arc cutting

(a) Effected by _____ with the heat of an _____ and pushing metal _____.

(b) No _____ needed.

(c) Standard welding _____ _____ used.

(d) Superior to _____ cutting when cutting plate less than 1/4".

(e) Superior when cutting _____ metal.

(f) Temperature range from _____ to _____.

(g) Generator amps must be _____ than is welding.

(h) Same equipment as used in welding.

D. Underwater Welding

1. Electrodes

a. Sizes: _____ or _____ depending upon metal being welded. _____ size recommended.

b. Waterproofing

(1) _____.

(2) _____.

(3) _____ 1/2 lb. 1 gal. _____.

(4) Clear _____.

(5) Dip rod completely.

(6) Allow _____ _____ to dry.

(7) Grind _____ _____ for good contact.

(8) Filler _____ electrode used in arc welding.

(a) Has _____ _____ which provides _____ for the _____ metal from the atmosphere.

1. Improves the properties of the _____ _____.

2. _____ the arc.

c. Types Recommended

(1) Same as used _____ when waterproofed.

(a) _____ _____.

(b) _____.

(c) _____ _____ 37.

(2) All are Navy Grade _____ Type for _____/_____ all position welding.

2. Uses and Limitations

a. Weld _____ patches.

b. Weld _____, _____, and _____.

c. Welding leaking _____.

d. Must not be of irregular _____.

e. Patch must fit _____ of _____.

f. No cap over _____.

g. Thickness of patch is of no value if _____ _____ _____ has been weakened.

h. Any weld is considered _____.

3. Techniques

a. Flatwell "Fillet"

(1) Set _____.

(2) ____° to ____° angle.

(3) _____-_____ method.

(4) Slight _____ pressure.

(5) Most _____ technique.

b. Vertical Weld

(1) Set _____.

(2) ____° to ____° angle.

(3) _____-_____ method.

(4) Slight pressure ____° from position of weld.

c. Overhead Weld

(1) Set current.

(2) ____° to ____° angle.

(3) Self-Consuming method.

4. Power Cable

a. Used to deliver _____ from _____ to electrode holder.

b. Cable lead.

(1) Size: ____/____ minutes.

(2) _____ft length to prevent excessive _____ drop.

(3) Type _____ m.i. _____.

(4) Electrode holder last _____ feet _____.

(a) Used to give diver _____ in maneuvering the electrode holder.

(5) All connectors should be _____ for complete _____.

(6) Contact resistence kept to a minimum by insuring connectors are _____ and _____.

(7) _____ _____ can cause current leakage, and rapid deterioration of the _____ _____.

5. Ground Cable

a. Same size as power cable _____ ____ _____.

b. Positioned as _____ to work as possible.

c. Positioned so the diver will not get _____ _____ and _____.

d. Must be _____ side of generator.

6. Knife Switch

a. _____ operating disconnecting _____ switching electrode _____.

(1) Electric _____ or _____.

(2) Designed to _____ diver.

(3) Switch _____ _____ when diver is cutting or welding.

(4) Switch is _____ when changing electrodes.

(5) _____ pole single throw _____ amp. _____ volt _____ type.

(6) Switch is designed so that it cannot be _____ accidently.

(7) Switch must be in a _____ position to operate.

(8) _____ _____ will operate the knife switch and have no other job.

7. Generators

a. _____ _____ to electrode for welding and cutting.

b. At least _____ amp capacity.

c. _____ current not recommended:

(1) _____.

(2) Requires greater _____.

d. _____ current recommended.

(1) _____ easier to maintain.

e. Straight Polarity.

(1) Work is _____.

(2) Electrode is _____.

(3) Current flows from _____ to _____.

f. Reverse Polarity.

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(1) Should _____ ___ _____.

(2) Causes _____ of electrode holder and lead.

g. Determining correct polarity.

(1) _____ generator.

(2) Connect electrode to _____ _____.

(3) Insert electrode in _____.

(4) Place the tips of both electrodes in a container of _____ _____.

(5) Insure operator is properly _____.

(6) _____ generator.

(7) Hold tips one or two inches _____.

(8) _____ will flow from the _____ pole.

(9) Practically none will flow from the _____ pole.

h. Types.

(1) _____.

(2) _____.

(3) _____.

i. Generators Cutting.

(1) _____ amp capacity.

(2) Recommended for Shielded Metal Arc Cutting

j. Wet Suit

(1) _____ use only when welding or electrical cutting.

(a) Suit must be ___ of _____ and _____.

(b) Not compressed below _____ wet.

(c) Can be used _____ _____.

FOR OFFICIAL USE ONLY

STUDENT GUIDE

FOR

DIVER, SECOND CLASS (A-433-0022)

VOLUME K

Diving Equipment Repair

PREPARED BY

NAVAL SCHOOL DIVING AND SALVAGE

PREPARED FOR

SERVSCOLCOM,SDIEGO

SUBTRACENPAC,PHARBOR

NAVSCOLDIVSAL,WASH

31 OCTOBER 1975

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INFORMATION SHEET 11-1-1I

TITLE: Diving Equipment Repair

INTRODUCTION

In past units in your diving course, you have learned the various components of the Mk V Deep Sea Diving System--what they are, what they do, and how they work. By now, you should have gained a relatively high degree of expertise in the Mk V System. This unit will provide even more knowledge, because during this unit, you will learn how to repair the equipment.

The step-by-step procedures contained within this Student Guide (Information Sheets), have been extracted from a previous Diving Equipment Repair Instructor Guide. They are contained herein as a supplement to the U.S. Navy Diving Manual.

I. Air testing for repair.
   A. Secure diving dress to blanked breastplate.
      1. Use same method as if placing on the diver.
      2. Open air valve, do not exceed two (2) pounds. air pressure.
      3. Locate leaks and circle with chalk.
      4. Secure air pressure.
      5. Remove dress from blanked breastplate.

II. Repairing worn or torn dresses.
   A. Insure area to be patched is dry.
   B. Clean area to be patched, use Trichlorethelyne.
   C. Trim loose threads.
   D. Measure and cut patch, cut one (1) inch larger than hole to be patched, rounding all corners.
   E. Strip protecting cloth from patch and lay on a flat board.
   F. Roughen area with sandpaper or clean with wire brush or benzine.
   G. Apply three (3) coats of B.F. Goodrich #4 rubber cement to both dress and patch allowing each coat to dry until it is tacky.
   H. Lay patch on the dress firmly and working from center out with a roller, remove all air bubbles.
   I. Use shears to trim patch if edges curl or do not otherwise stick.
   J. Locate leak inside of dress and follow same procedure.
   K. Do NOT use for twenty-four (24) hours.
   L. Patching the crotch.
      1. Crotch patches applied the same as other patches with two exceptions:

a. A breastplate stand is used.
b. Pressurize suit to 1/2 pound.
(1) Pull suit over the stand as putting on stockings on the foot.
(2) Follow same procedure as for outer patches.

M. Lacing flaps and grommets.
1. Mark dress top and bottom of flap(s) for proper alignment of new flap.
2. Cut new flaps, strip protective cloth from patch and apply to both patches as outlined before, leaving 1 1/4" of the straight edge uncemented, and place together, back to back.
3. After flap has set, cement area on dress and remaining 1 1/4" of flap and follow procedures outlined before.
4. When replacing grommets in flaps, #2B size grommet should be used.

N. Repairing the rubber collar.
1. Cement tear together and sew using a herring-bone stitch.
2. Fill the needle holes with cement and allow to dry.
3. Cut patches for both sides, inner and outer, cement and allow to dry.

III. Replacing gloves or cuffs.
A. Renewing gloves.
1. Insert wooden plug in sleeve, small end facing down, should extend out about four (4) inches.
2. Loosen lower part of elbow patch and fold back.
3. Roughen outside of sleeve edge up about three (3) inches.
4. Cut upper edge of glove.
a. Cut off one (1) inch to fit a size three (3) dress.
b. Cut off two (2) inches to fit a size two (2) dress.
c. Cut off three (3) inches to fit a size one (1) dress.
5. Fold back two (2) inches of glove gauntlet and place glove up and over sleeve plug until it touches sleeve.
6. Roughen folded area of glove and apply three (3) coats of cement to glove and sleeve.
7. Roll glove gauntlet up over sleeve and roll out all air bubbles.
8. Cut two (2) curved strips of patching cloth using templates provided.
9. Roughen and cement same as for other patches and apply evenly over joint between glove and sleeve.

10. Turn dress inside out and apply other strip in a like manner.

B. Renewing cuffs.
   1. Insert wooden plug same as for gloves.
   2. Follow all steps outlined for replacing gloves with the exception, "DO NOT TRIM OR CUT CUFF EDGE."

IV. Proper care and stowage of diving dresses.
   A. Dresses have average cost exceeding $100.00
   B. To get maximum use of diving dress, follow rules listed.
      1. Use new dresses for HeO_2 diving until patched
      2. Use proper patching procedures
         a. Never patch wet
         b. Patch both inside and out
         c. Renew chafing patches when needed
         d. Allow twenty-four (24) hours before using for dry time
      3. Never allow dresses to hang over the side of throw on deck. Use hangers provided.
      4. Never throw dresses or drop with hanger inside, as it will cut the sleeve or dress.
      5. Never stow dresses away wet or damp. Allow to dry outside and inside. After each dive in salt water, rinse off with fresh water.

V. Repairing Belts
   A. To repair belt, remove weights and sew
   B. To repair shoulder straps or renew, sew or cut off old ones and cut new straps, double and sew.
   C. To replace old buckles, remove weight, replace with new buckle.
   D. When changing weights, care must be taken to place right and left weights on proper sides.
   E. Care and maintenance
      1. Remove all weights and backing grommet plates.
      2. Use stiff bristle brush to remove accumulation of dirt and oil from leather.
      3. Apply thin coat of Neets Foot Oil to both sides of belt and shoulder straps.
      4. Wire brush and shine backing grommet plate.
      5. Reassemble.

VI. Repairing Shoes
   A. Repair bent or cracked toe cap, remove and lightly strike with a hammer, or braze crack.
   B. To repair cracked sole, remove and pebble solder.
   C. To repair buckles or straps, remove and manufacture new.
   D. Care and maintenance

1. Remove toe cap and use a stiff bristle brush to wipe off accumulation of dirt and oil.
2. Apply a coat of Neets Foot Oil to outside leather upper.

VIII. Maintaining the telephone/lifeline and air hose
- A. Making up
  - 1. Marrying lifeline and air hose
    - a. Use jigger to stretch out lifeline between jackstays four (4) feet off deck.
    - b. Connect air hose to 150 psi air manifold with female coupling toward the diver.
    - c. Measure back from jack plug thirty-one (31) inches and mark with chalk.
    - d. Measure back twenty-two (22) inches from the first mark. Mark with chalk.
    - e. Place female coupling of air hose on first mark, temporarily stop off.
    - f. At second mark, take eight (8) turns around telephone/lifeline and air hose, take two (2) turns between lifeline and air hose and tie with square knot - square knot is hidden.
    - g. Continue every three (3) feet, leaving four (4) inches of slack between air hose and lifeline.
  - 2. Canvas Boot
    - a. Used as chafing
      - (1) Sewing canvas boot on telephone/lifeline and air hose
        - (a) Cut strip of #6 canvas fourteen (14) inches wide and fifty (50) feet long.
        - (b) Double canvas and wrap around lifeline and air hose.
        - (c) Start sewing at second chalk mark using a herringbone stitch.
        - (d) After sewing on fifty (50) feet piece of canvas, secure.
        - (e) If desired, a "fancy knot" may be put at ends of canvas boot and boot painted. Soak canvas with water and paint.
- B. Testing
  - 1. Telephone/lifeline and air hose
    - a. Visual
      - (1) Check points of wear a few inches from either end of cable due to bending at these when under tension.
    - b. Mechanical
      - (1) Connect jacks to amplifier and diver's reproducer.

(2) Make verbal contact
(3) If no contact, test for short circuit with megger or Ohm Meter
(a) There will be a complete electrical circuit from the metal sleeve of the amplifier to the other plug through the wires.
(b) If an open or short circuit develops in the jack plug, jack plus [illegible] moved and check each wire until [illegible] is found. Repair and replace jack plug.

2. Air Hose
a. Visual
(1) Inspect hose at points of wear and at each connection for loose couplings and air bubbles under the rubber coating.
b. Mechanical
(1) Diving hose when manufactured, is required to withstand a working pressure of 600 psi and a proof pressure of 1200 psi held for one minute. One length is selected at random from each lot of the same date of manufacture as a representative length and subjected to a burst pressure test of 2400 psi instanteously.
(2) Hose in storage over three (3) years will be surface inspected and hydrostatically tested of 600 psi concurrent with an axial tensile load of 250lbs held for one minute.*
(3) Hose subjected to the burst pressure test will not be used for diving. Remove couplings and discard hose.
(4) Upon reaching five (5) years from date of manufacture and annually thereafter up to and including nine (9) years, hose shall be subjected to the above testing, and in addition, each year a randomly selected hose representing each lot shall be subjected to a burst strength test as in (1) above. This testing will continue until hose failure or until the hose reaches the age of 10 years, whichever comes first.
(5) Hose over three (3) years old will not be used for diving at HeO_2 facilities.
(6) If hydrostatic test cannot be made, the hose should be subjected to a 350 psi air pressure test with a concurrent elongation load of 250 pounds on the coupling held for one (1) minute.

* 75% of the manufacturer's test held for one minute.

(c.) If facilities are not available to conduct the required tests and it is necessary to use the hose, it should be subjected to a pressure at least 100% greater than the maximum pressure to be applied topside and held for ten (10) minutes.
FORMULA: Test Pressure = 2(25 + .71D)

C. Maintenance
1. Telephone/Lifeline
a. If bubble has formed in outer rubber covering of cable.
(1) Puncture with a pin and wrap with several layers of rubber tape, using rubber cement between each layer.
(2) Cover rubber tape with friction tape.
(3) Thoroughly shellac.
b. Vulcanize, if possible.
c. After repair and before returning cable to use:
(1) Open jack plug and inspect for leaks in sealing compound
(2) If leaks are apparent, reseal by pouring melting sealing compound or beeswax into open end of housing to within 1/4 inch of plug.
d. Jack Plug Removal
(1) Unscrew gland nut at rear of plug housing.
(2) Remove packing
(3) Remove lock nut at front of plug housing with spanner wrench.
(4) Heat plug housing to soften the sealing compound.
(5) Slide plug housing back on cable away from plug.
(6) Loosen connections to plug terminals and remove plug.
(7) Melt solder which secures stainless steel core in the anchor plug, and remove the wood screw wedge and anchor plug.
(8) The cable may be cut back to the damaged end and communication tested.

e. Reassembly of jack plug
(1) Slide gland nut and jack plug housing onto cable.

(2) Remove two outer rubber coverings for a distance of about four (4) inches, remove rubber covering of stainless steel core for four (4) inches.
(3) Separate exposed strands, core and tin thoroughly.
(4) Slip anchor plug over tinned strands and core, bring up as close as possible to rubber covering.
(5) Distribute strands and core around circumference of hole in plug and drive in wood screw for wedge.
(6) Solder steel core and wedge securely into anchor plug.
(7) Cut off loose ends of steel core even with anchor plug, smooth with file.
(8) Bare ends of conductors and twist together into two (2) pairs, red with green and black with white.
(9) Form eye in end of each pair and solder.
(10) Pull plug housing down over anchor plug as far as possible. The length of conductor should be about 1/4 inch out of plug housing.
(11) Several turns of flax packing should be inserted into gland and gland nut screwed in tight.
(12) Place thin leather washer over conductors and attach conductors to plug terminals making sure that red and green pairs are connected to side terminal and black and white pair to center terminal.
(13) Pour melted sealing compound or beeswax into open end of housing to within 1/4 inch of plug seat.
(14) While sealing compound is still soft, seat jack plug in housing, making certain that leather washer is properly situated on seat.
(15) Screw in locking nut and pull up tight.

2. Repairing broken hose.
   a. Hose is cut square and sealed with rubber cement.
   b. Slip three (3) hose clamps over end of the hose.
   c. Coat shank of coupling with rubber cement and clamp in coupling vise.
   d. Turn coupling vise handle until hose is a against shank of coupling.

e. First clamp is placed in position and set into a vise. Screw up on vise until clamps are compressed, and clamp screw holes are in line. Clamp screw is them screwed in place.
f. Repeat for second and third clamp.
NOTE: When storing hose on a jack stay always bleed air pressure from hose and prior to using after hose has not been used for some time, flush hose thoroughly.

VIII. Air Helmet
A. Mk V, Mod O
1. Renewing face plate glass and port glasses
a. Remove face plate guard. Four (4) 8-32 3/8" machine screws.
b. Remove old glass.
c. Clean face plate on port with wire brush and scraper.
d. Prepare mixture of litharge and glycerin or lead monoxide (red) and glycerin of 60/40 proportions.
(CAUTION: Fast drying)
e. Place liberally in port ring.
f. Place glass in and tap in place firmly.
g. Scrape off excess litharge mixture and wipe and clean with rag.
h. Replace port on face plate guard and allow to dry at least eight (8) hours prior to use.
2. Replacing Secondary Exhaust Valve (Spitcock)
CAUTION: Heat Radiation
a. Use torch to melt solder from retaining ring.
b. Unscrew retraining ring.
c. Use torch to melt solder from valve and helmet shell.
d. Insure new valve is clean.
e. Insure helmet shell is clean around valve recess.
f. Insert new valve and screw down retaining ring.
g. Soft solder retaining ring and helmet shell.
h. Soft solder valve base to helmet shell.
NOTE: Caution must be taken not to use too much heat as to melt soft solder on the retaining ring and helmet.
3. Replacing Air Regulating Exhaust Valve
a. Remove 8-32 3/8" machine screws from valve bonnet guard.
b. Unscrew valve bonnet.
c. Replace defective parts (use bright work polish to clean and lap valve seat).

d. Reassemble valve.
e. Screw down valve bonnet.
f. Check valve for proper setting.
g. Replace valve bonnet guard and screw in the 2 8-32 screws.

4. Replacing safety latch.
   a. Drive out dowel pin using proper size drift pin.
   b. Use torch to melt solder from helmet and latch base.
   c. Use torch to melt solder from backing plate.
   d. File down peened over stud.
   e. Use drift pin to drive out stud and latch base.
   f. Clean area around hole for latch base.
   g. Insert new latch base.
   h. Place backing plate over latch base stud.
   i. Use machinest hammer to peen over stud.
   j. Solder over stud and backing plate.
   k. Solder around latch base and helmet shell.
   l. Place new dumb bell in latch base.
   m. Insert dowel pin and peen over both ends.

NOTE: Caution must be taken not to pinch dumb-bell base when peening over dowel pin.

5. Replacing air and/or telephone goosenecks.
   a. File off rivet heads.
   b. Use torch to melt solder from gooseneck and helmet.
   c. Use torch to melt solder from backing plate and helmet.
   d. Replace gooseneck.
   e. Insert through gooseneck and backing plate.
   f. Peen over rivets.
   g. Solder backing plate to helmet.
   h. Solder around gooseneck and helmet.

6. Install telephone transceivers in helmet.
   a. Remove transceiver.
      (1) Disconnect wires inside helmet.
      (2) Remove the two bracket nuts.
      (3) Lift out receiver.
   b. Removing the helmet gooseneck jack.
      (1) Remove the two holding screws.
      (2) Heat and remove sealing compound.
      (3) Remove jack from gooseneck.
      (4) Clean gooseneck.
   c. Replacing the helmet gooseneck jack.
      (1) Solder a 12" insulated wire to each of the terminals (If leads are not finished).
      (2) Insert the jack in gooseneck.
      (3) Insert the jack element, wires down into the goooseneck and secure with two 3/8" 8-32 machine screws and nuts, trim and

attach lead to reproducer and secure unit in place.
(4) Test before resealing. Reseal with sealing compound (wax or electrical sealing compound. Place jack in contact to keep from fouling).

d. Replacing tranceiver.
(1) Place transceiver in recess over studs.
(2) Replace two holding nuts on studs and tighten down.
(3) Splice and tape wires inside helmet.
(4) Test.

7. Renew helmet gasket in breastplate.
a. Removing old gasket.
b. Trimming new gasket.
c. Fitting new gasket.
d. Care and maintenance of gaskets.
e. Shimming of old gasket (gaskets are interchangeable)(Recesses are different in depth).

8. Breastplate studs.
a. Use torch to remove solder from around stud.
b. Clean stud and stud hole.
c. Solder in new stud.

NOTE: CAUTION HEAT RADIATION.
EXPLAIN: Solder (50/50) is used on helmet and breastplate because of its low melting point.

9. Breastplate padeyes.
a. Use torch to melt solder from backing plate and breastplate.
b. File off peened over stud and remove backing plate.
c. Clean padeye, backing plate and breastplate.
d. Insert padeye.
e. Place backing plate over stud and peen over.
f. Solder backing plate and stud to breastplate.
g. Solder padeye to breastplate.

IX. HeO2 helmet.
A. Standard Mark V Air Helmet with modifications.
1. Canister goosenecks riveted to helmet and soft solder.
a. Receive CO2 absorbent canister.
b. Left side - open to helmet.
c. Right side - contains venturi, system (pp.251, fig 2-34, pp.252, fig 2-35).
(1) Aspirator elbow - standard O2 hose threads for aspirator hose one end, standard 1/4" IPS threads other. Use single layer teflon tpe or O2 sealant to seal. Use cresent wrench to remove.
(2) High pressure nozzle - receives aspirator

elbow 1/4" IPS threaded end and screwed into aspirator body with 3/4" wrench. Check nozzle with NO. 72 drill bit inverted in vise pin.

(3) Discharge nozzle (venturi).
   (a) Screws into bottom of aspirator body into canister.
   (b) Metal to metal contact.
   (c) Use 7/8" wrench to remove.

2. Canister.
   a. Screws to helmet goosenecks with neoprene or koroseal gaskets both sides. Left side has canister screen recess
   b. Take up nuts evenly by hand, to remove use 3" wrench.
3. Exhaust valve.
   a. Standard air regulating escape valve.
   b. Set 2 1/2 turns heavy.
4. Air escape channel and secondary exhaust.
   a. Soft soldered to helmet.
   b. Channel moved to top of helmet with secondary exhaust.
   c. Secondary exhaust three pieces. Bottom section screwed to channel with six (6) 8-32 3/8" machine screws with a rubber gasket inserted.
   d. Center section screwed on by special wrench.
   e. Top section screwed on hand tight only.
5. Secondary exhaust valve (spit cock) removed entirely.
6. Safety ball locking device (dumbbell) moved to front where spit cock was.
7. Electric underwear gooseneck. (No longer used) Riveted to a backing ring, peened and soft soldered.
8. Lifting ring (Padeye).
   a. Riveted to backing ring, peened and soft soldered.
   b. Helmet with modifications and full cannister weights approximately 103 pounds.

B. Associated equipment.
1. Air control valve.
   a. Standard valve with hexagonal adaption for hoke valve.
   b. Hoke valve - special 1/4" IPS threads one end, O2 hose threads other.
2. Hose leaders.
   a. Standard diving hose leader, 3'9" long.
   b. Aspirator hose - standard 5/16" O2 hose, 54" long.

X. Lightweight mask repair.
   A. Non-return valve.
      1. Disassemble and check for defects.
      2. Replace faulty parts.
      3. Clean.
      4. Reassemble and test.
   B. Air supply valve.
      1. Disassemble and check for defects.
      2. Replace faulty parts.
      3. Clean and reassemble.
      4. Tighten down packing nut and test.
   C. Exhaust valve.
      1. Disassemble and check for defects.
      2. Replace rubber disc if necessary.
      3. Tighten retainer nut on mask.

732 ASSIGNMENT SHEET 11-1-1A

TITLE: Diving Equipment Repair - Mk V Deep Sea Diving System Helmet

LESSON TOPIC OBJECTIVES

Terminal Objective

1. When the student completes this course he will be able to, given a Mk V Deep Sea Diving System Helmet, perform the following maintenance so that the equipment may be used in diving operations: Replace port glass, replace breastplate gasket, and replace breastplate stud. Additional maintenance items are to be accomplished dependent upon time and equipment requirements.
   a. Replace breastplate padeye.
   b. Replace telephone jack in gooseneck.
   c. Replace reproducer.
   d. Chase threads on the Air Gooseneck, Telephone Gooseneck, and Breastplate Studs.
   e. Replace safety locking device.
   f. Replace or lap in the Supplementary Exhaust Valve.
   g. Lap in and adjust the Exhaust Valve.
   h. Replace face plate and gasket.
   i. Test communications.
   j. Make new lanyards for the breastplate eyelets and install them.

Enabling Objectives

1. For each of the repairs/maintenance requirements listed above:
   a. Orally state the common cause(s) of the equipment damage/failure/leak which would lead to repairing or replacing the specific piece of equipment.
   b. List, in writing, the tools needed for the specific repair.
   c. Explain, in writing, step-by-step procedures for effecting the repair or replacement.
   d. Orally explain the importance of doing proper repairs--including results if repair procedures are not carried out properly.

STUDY ASSIGNMENT

Student Guide, Volume K, Information Sheet 11-1-1I through 11-1-12I, Job Sheet 11-1-1J through 11-1-2J
U.S. Navy Diving Manual, Volume 1, paragraph 6.1.1.1 and 6.5.1.1.

ASSIGNMENT SHEET 11-1-2A

STUDY QUESTIONS

1. When replacing a port glass in the Mk V Deep Sea Diving System Helmet, which of the following is the mixing ratio of litharge and glycerin?

   a. two parts litharge to one part glycerin.
   b. two parts glycerin to one part litharge.
   c. one part litharge to one part glycerin.
   d. none of the above.

2. When replacing a safety latch, what tool is used to peen over the stud?

3. When replacing a helmet gooseneck jack, which of the following is accomplished first? Second?

   Reseal with sealing compound.
   Test.
   Insert the jack in gooseneck.

4. What is vertigris?

5. How should helmets, breastplates, and associated equipment be stored?

6. How can a hardworking spitcock be repaired?

7. How often should the exhaust valve be inspected? What should you look for?

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ASSIGNMENT SHEET 11-2-1A

TITLE: Diving Equipment Repair - Mk V Deep Sea Diving System Dress

LESSON TOPIC OBJECTIVES

Terminal Objective

1. When the student completes this course he will be able to, given a Mk V Deep Sea Diving System Dress, perform the following maintenance so that the equipment may be used in diving operations: Placing/replacing gloves, patching a hole, air test dress before/after patching. Additional maintenance items are to be accomplished dependent upon time and equipment requirements.
   a. Replacing lacing flaps.
   b. Replacing crotch flap.
   c. Repair and patch torn rubber gasket on collar.
   d. Renew lead weights on Mk V Deep Sea Diving System Weight Belt.
   e. Renew straps and buckles on Mk V Deep Sea Diving System Shoes.
   f. Clean and preserve Mk V Deep Sea Diving System Shoes.

Enabling Objectives

1. For each of the repairs/maintenance requirements listed above:
   a. Orally state the common cause(s) of the equipment damage/failure/leak which would lead to repairing or replacing the specific piece of equipment.
   b. List, in writing, the tools needed for the specific repair.
   c. Explain, in writing, step-by-step procedures for effecting the repair or replacement.
   d. Orally explain the importance of doing proper maintenance to include results if repair procedures are not carried out properly.

STUDY ASSIGNMENT

Student Guide, Volume K, Information Sheet 11-1-1I through 11-1-12I, Job Sheet 11-2-1J through 11-2-3J
U.S. Navy Diving Manual, Volume I, paragraph 6.1.1.2 and 6.5.1.2.

STUDY QUESTIONS

1. When repairing a torn Mk V Deep Sea Diving System Dress, how large should the patch be?

2. A newly patched dress cannot be used for at least ____ hours.

3. What size grommets are used in the lacing flaps?

4. When putting gloves on a diving dress, how much of the glove upper edge should be cut for a size three dress? Size one?

5. How is a diving dress checked for leaks?

6. How can you be sure the glove is in proper position when repairing a diving dress?

7. When repairing/patching a diving dress, make sure the area is clean and dry by using _____.

736

ASSIGNMENT SHEET 11-3-1A

TITLE: Diving Equipment Repair - Mk V Deep Sea Diving System Umbilical

LESSON TOPIC OBJECTIVES

Terminal Objective

1. When the student completes this course, he will be able to, given components of the Mk V Deep Sea Diving System Umbilical, perform the following maintenance so that the equipment may be used in diving operations: Marry lifeline/air hose, and repair or replace jack plug on lifeline, telephone cable. Additional maintenance items are to be accomplished dependent upon time and equipment requirements.

Enabling Objectives

1. For each of the repairs/maintenance requirements listed above:
   a. Orally state the common cause(s) of the equipment damage/failure/leak which would lead to repairing or replacing the specific piece of equipment.
   b. List, in writing, the tools needed for the specific repair.
   c. Explain, in writing, step-by-step procedures for effecting the repair or replacement.
   d. Orally explain the importance of doing proper maintenance to include results if repair procedures are not carried out properly.

STUDY ASSIGNMENT

Student Guide, Volume K, Information Sheet 11-1-1I through 11-1-12I, Job Sheet 11-3-1J and 11-3-2J
U.S. Navy Diving Manual, Volume I, paragraphs 6.1.1.3 and 6.5.1.3.

STUDY QUESTIONS

1. When marrying lifeline and air hose, how far back from the jack plug should the first tie be made?

2. At what intervals are ties made on the umbilical of a Mk V Deep Sea Diving System?

3. When putting a convas boot on an umbilical, how large is the piece of canvas used?

4. Hose stored for two years will be surface inspected and _____ tested to _____ of the manufacturer's tests.
   (a) Working Pressure -
   (b) Proof Pressure -
   (c) Burst Pressure -

5. List 2 instances where air hoses could not be used for diving.

1.

2.

6. When reassembling a jack plug, the length of conductor should be about _____ out of plug housing.

7. When storing hose on a jack stay always _____ _____ _____ from hose and prior to using, after hose has not been used for sometime, _____ _____ thoroughly.

8. What should be done to a new air hose prior to diving with it?

9. Why is it most important to inspect the lifeline/amplifier cable within 1 foot of either end?

ASSIGNMENT SHEET 11-4-1A

TITLE: Diving Equipment Repair - Mk V Deep Sea Diving System Non-Return Valve

LESSON TOPIC OBJECTIVES

Terminal Objective

1. When the student completes this course he will be able to, given a Mk V Deep Sea Diving System Non-Return Valve, perform the following maintenance so that the equipment may be used in diving operations: Replace the stem and seat, and replace the spring and gasket.

Enabling Objectives

1. For each of the repairs/maintenance requirements listed above:
   a. Orally state the common cause(s) of the equipment damage/failure/leak which would lead to repairing or replacing the specific piece of equipment.
   b. List, in writing, the tools needed for the specific repair.
   c. Explain, in writing, step-by-step procedures for effecting the repair or replacement.
   d. Orally explain the importance of doing proper maintenance to include results if repair procedures are not carried out properly.

STUDY ASSIGNMENT

Student Guide, Volume K, Information Sheet 11-1-1I through 11-1-12I, Job Sheet 11-4-1J
U.S. Navy Diving Manual, Volume 1, paragraphs 6.1.1.1 and 6.5.1.3.

STUDY QUESTIONS

1. After reassembly of a "spring and stem" non-return valve, an inspection reveals that the leather gasket has spread into the air passage. What would this indicate?

ASSIGNMENT SHEET 11-5-1A

TITLE: Diving Equipment Repair - Mk V Deep Sea Diving System Air Control Valve

LESSON TOPIC OBJECTIVES

Terminal Objective

1. When the student completes this course he will be able to, given a Mk V Deep Sea Diving System Air Control Valve, perform the following maintenance so that the equipment may be used in diving operations: Lap in needle valve, renew flax packing in packing gland and adjust packing gland.

Enabling Objectives

1. For each of the repairs/maintenance requirements listed above:
   a. Orally state the common cause(s) of the equipment damage/failure/leak which would lead to repairing or replacing the specific piece of equipment.
   b. List, in writing, the tools needed for the specific repair.
   c. Explain, in writing, step-by-step procedures for effecting the repairs or replacement.
   d. Orally explain the importance of doing proper maintenance to include results if repair procedures are not carried out properly.

STUDY ASSIGNMENT

Student Guide, Volume K, Information Sheet 11-1-1I through 11-1-1I, Job Sheet 11-5-1J
U.S. Navy Diving Manual, Volume 1, paragraphs 6.1.1.3 and 6.5.1.3.

STUDY QUESTIONS

1. The Air Control Valve packing is adjusted so that the valve will _____ _____ _____ to _____ _____ _____, but _____ and _____ enough so that it can be _____ by a _____ wearing relatively clumsy _____/_____ _____.

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JOB SHEET 11-1-1J

TITLE: Diving Equipment Repair

INTRODUCTION

Properly maintained gear is safe gear. That is the truth plainly and simply stated. If you inspect the diving gear before diving with it, many problems will be eliminated. If it is found that repairs to diving equipment are necessary, and they are done properly, many problems will be eliminated. One of the most important jobs a diver has is maintaining his gear.

This unit is designed to provide you the knowledge necessary to be able to make repairs and a limited amount of practical experience dependent upon time and equipment availability. Important to remember in this unit and on your job in a diving locker; (1) follow the Planned Maintenance System (PMS) for routine periodic maintenance, (2) inspect the equipment before (and after) each dive, and (3) when maintenance must be performed, take your time and do it right. Your life or the life of a fellow diver will depend upon it!

REFERENCES

U.S. Navy Diving Manual, Volume 1

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JOB SHEET 11-1-2J

TITLE: Diving Equipment Repair - Mk V Deep Sea Diving System Helmet

EQUIPMENT AND MATERIAL

Mk V Deep Sea Diving System Helmet needing repair, slotted screwdriver, hand wire brush, litharge and glycerin, breastplate gasket mandrel, sanding block, sandpaper, knife, scribe, breastplate gasket material, breastplate stud, 50/50 soft solder, propane torch, flux, breastplate stand, 1/2" X 12 thread die, wet rags.

1. Renewing face plate glass and port glasses.
   a. Remove face plate guard. Four (4) 8-32 3/8" machine screws.
   b. Remove old glass
   c. Clean faceplate on port with wire brush and scraper.
   d. Prepare mixture of litharge and glycerin or lead monoxide (red) and glycerin of 60/40 proportions. (CAUTION: Fast drying)
   e. Place liberally in port ring.
   f. Place glass in and tap in place firmly.
   g. Scrape off excess litharge mixture and wipe and clean with a rag.
   h. Replace port on faceplate guard and allow to dry at least eight (8) hours prior to use.

2. Renew helmet gasket in breastplate.
   a. Removing old gasket.
   b. Trimming new gasket.
   c. Fitting new gasket.
   d. Care and maintenance of gaskets.
   e. Shimming of old gasket (gaskets are interchangeable) (Recesses are different in depth).

3. Breastplate studs.
   a. Use torch to remove solder from around stud.
   b. Clean stud and stud hole.
   c. Solder in new stud.

NOTE: CAUTION! HEAT RADIATION

EXPLAIN: Solder (50/50) is used on helmet and breastplate because of its low melting point.

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JOB SHEET 11-2-1J

TITLE: Diving Equipment Repair - Mk V Deep Sea Diving System Dress

EQUIPMENT AND MATERIALS

Mk V Deep Sea Diving System Dress needing repair, #4 Goodrich glue, D/C plug (5 3/4" to 3 1/2"), roller, trichloretholyne, wire brush, scissors, Mk V Deep Sea Diving System gloves, patch templates, patching material, breastplate test stand, low pressure air system, chalk.

1. Air testing for repair.
   a. Secure diving dress to blanked breastplate.
      (1) Use same method as placing on the diver.
   b. Open air valve, do not exceed two (2) pounds air pressure.
   c. Locate leaks and circle with chalk. If necessary, use soap and water to locate leak.
   d. Secure air pressure.
   e. Remove dress from blanked breastplate.

2. Repairing worn or torn dresses.
   a. Insure area to be patched is dry. Dry for a minimum of 24 hours before repairing.
   b. Clean area to be patched, use Trichlorethelyne.
   c. Trim loose threads.
   d. Measure and cut patch, cut one (1) inch larger than hole to be patched, rounding all corners.
   e. Strip protecting cloth from patch and lay on a flat board.
   f. Roughen area with sand paper or clean with wire brush or benzine.
   g. Apply three (3) coats of B.F. Goodrich #4 rubber cement to both dress and patch allowing each coat to dry until it is tacky.
   h. Lay patch on the dress firmly and working from center out with a roller, remove all air bubbles.
   i. Use shears to trim patch if edges curl or do not otherwise stick to dress.
   j. Locate leak inside of dress and follow same procedure.
   k. Do NOT use for twenty-four (24) hours.
   l. Patching the crotch.
      (1) Crotch patches applied the same as other patches with two exceptions:
         (a) a breastplate stand is used.
         (b) pressurize suit to 1/2 pound.
         1. Pull suit over the stand as putting on stockings on the foot.
         2. Follow same procedure as for outer patches.
   m. Lacing flaps and grommets.

(1) Mark dress top and bottom of flap (s) for proper alignment of new flap.
(2) Cut new flaps, strip protective cloth from patch and apply to both patches as outlined before, leaving 1 1/4" of the straight edge uncemented, and place together, back to back.
(3) After flap has set, cement area on dress and remaining 1 1/4" of flap and follow procedures outlined before.
(4) When replacing grommets in flaps, #2B size grommet should be used.

3. Replacing gloves or cuffs.
   a. Renewing gloves
      (1) Insert wooden plug in sleeve, small end facing down, should extend out about four (4) inches.
      (2) Loosen lower part of elbow patch and fold back.
      (3) Roughen outside of sleeve edge up about three inches.
      (4) Cut upper edge of glove.
         (a) Cut off one (1) inch to fit a size three (3) dress.
         (b) Cut off two (2) inches to fit a size two (2) dress.
         (c) Cut off three (3) inches to fit a size one (1) dress.
      (5) Fold back two (2) inches of glove gauntlet and place glove up and over sleeve plug until it touches sleeve.
      (6) Roughen folded area of glove and apply three (3) coats of cement to glove and sleeve.
      (7) Roll glove gauntlet up over sleeve and roll out all air bubbles.
      (8) Cut two (2) curved strips of patching cloth using templates provided.
      (9) Roughen and cement same as for other patches and apply evenly over joint between glove and sleeve.
      (10) Turn dress inside out and apply other strip in a like manner.
   b. Renewing cuffs.
      (1) Insert wooden plug same as for gloves.
      (2) Follow all steps outlined for replacing gloves with the exception, "DO NOT TRIM OR CUT CUFF EDGE".

4. Proper care for and stowing diving dresses.
   a. Dresses have average cost exceeding $100.00.
   b. To get maximum use of diving dress, follow rules listed.
      (1) Use new dresses for HeO2 diving until patched.
      (2) Use proper patching procedures.
         (a) Never patch wet.

(b) Patch both inside and out.
(c) Renew chaffing patches when needed.
(d) Allow twenty-four (24) hours before using for dry time.

(3) Never allow dresses to hang over the side or throw on deck. Use hangers provided.

(4) Never throw dresses or drop with hanger inside, it will cut the sleeve or dress.

(5) Never stow dresses wet or damp. Allow to dry outside and in. After each dive in salt water, rinse off with fresh water.

JOB SHEET 11-3-1J

TITLE: Diving Equipment Repair - Mk V Deep Sea Diving System Umbilical

EQUIPMENT AND MATERIAL

Mk V Deep Sea Diving System Umbilical components, 150 psi air supply, marline, knife, chalk, Mk V Deep Sea Diving System Air Control Valve.

1. Making up
   a. Marrying lifeline and air hose
      (1) Use jigger to stretch out lifeline between jackstays four (4) feet off deck.
      (2) Connect air hose to 150 psi air manifold with female coupling toward the diver.
      (3) Measure back from jack plug thirty-one (31) inches and mark with chalk.
      (4) Measure back twenty-two (22) inches from first mark and mark with chalk.
      (5) Place female coupling of air hose on first mark, temporarily stop off.
      (6) At second mark, take eight (8) turns around telephone/lifeline and air hose, take two (2) turns between lifeline and air hose and tie with square knot; square knot is hidden.
      (7) Continue every three (3) feet, leaving four (4) inches of slack betwen air hose and lifeline.

2. Repairing/replacing Jack Plug
   a. Jack Plug Removal
      (1) Unscrew gland nut at rear of plug housing.
      (2) Remove packing.
      (3) Remove lock nut at front of plug housing with spanner wrench.
      (4) Heat plug housing to soften the sealing compound.
      (5) Slide plug housing back on cable away from plug.
      (6) Loosen connections to plug terminals and remove plug.
      (7) Melt solder which secures stainless steel core in the anchor plug, and remove the wood screw wedge and anchor plug.
      (8) The cable may be cut back to the damaged end and communication tested.
   b. Reassembly of Jack Plug
      (1) Slide gland nut and jack plug housing onto cable.
      (2) Remove two outer rubber coverings for a distance of about four (4) inches, remove rubber covering of stainless steel core for four (4) inches.
      (3) Separate exposed strands, core and tin thoroughly.

(4) Slip anchor plug over tinned strands and core, bring up as close as possible to rubber covering.
(5) Distribute strands and core around circumference of hole in plug and drive in wood screw for wedge.
(6) Solder steel core and wedge securely into anchor plug.
(7) Cut off loose ends of steel core even with anchor plug, smooth with file.
(8) Bare ends of conductors and twist together into two (2) pairs, red with green and black with white.
(9) Form eye in end of each pair and solder.
(10) Pull plug housing down over anchor plug as far as possible. The length of conductor should be about 1/4 inch out of plug housing.
(11) Several turns of flax packing should be inserted into gland and gland nut screwed in tight.
(12) Place thin leather washer over conductors and attach conductors to plug terminals making sure that red and green pairs are connected to side terminal and black and white pair to center terminal.
(13) Pour melted sealing compound or beeswax into open end of housing to within 1/4 inch of plug seat.
(14) While sealing compound is still soft, seat jack plug in housing, making certain that leather washer is properly situated on seat.
(15) Screw in locking nut and pull up tight.

JOB SHEET 11-4-1J

TITLE: Diving Equipment Repair - Mk V Deep Sea Diving System Non-Return Valve

EQUIPMENT AND MATERIAL

Mk V Deep Sea Diving System Non-Return Valve, T Wrench, Neets Foot Oil, Scribe, vinegar, cartridge.

1. Stem and Seat Type
   a. Using scribe, remove leather gasket from non-return valve.
   b. Insert T wrench in slot or upper guide to remove stem assembly.
   c. Inspect disc and spring. Replace if necessary.
   d. Soak all parts, except washer, in vinegar.
   e. Apply Neets Foot Oil to washer.
   f. Wipe all parts dry and reassemble.

2. Cartridge Type.
   a. Replace cartridge. Cartridge has an arrow indicating direction of air flow.

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JOB SHEET 11-5-1J

TITLE: Diving Equipment Repair - Mk V Deep Sea Diving System Air Control Valve.

EQUIPMENT AND MATERIAL

Mk V Deep Sea Diving System Air Control Valve, screw driver, flax packing, adjustable wrench, bright work polish, clean rag, scribe.

1. Lapping Needle Valve, Renewing Flax Packing in Packing Gland and Adjusting Packing Gland.
   a. Remove valve wheel and bracket.
   b. Remove capnut and stuffing box gland.
   c. Use scribe to remove lead washers and flax packing.
   d. Use wrench to remove stuffing box.
   e. Remove copper washer and valve stem.
   f. Inspect disc (60° angle) and seat.
   g. If needed, lap in disc and seat with bright work polish.
   h. Clean disc and seat with clean rag before reassembling.
   i. Screw valve stem into the stuffing box.
   j. Place copper ring into the groove on top of valve body.
   k. Insert valve stem into body and tighten stuffing box wrench tight.
   l. Insert first lead washer over valve stem.
   m. Add new flax packing rings staggering the batts.
   n. Insert second lead washer.
   o. Insert the stuffing box gland and screw cap nut into position.
   p. Adjust so that valve will not turn easily.
   q. Replace screws in bracket.
   r. Replace valve wheel.
   s. Replace locking nut.
   t. Replace cotter key through locking nut.

FOR OFFICIAL USE ONLY

STUDENT GUIDE

FOR

DIVER, SECOND CLASS (A-433-0022)

VOLUME L

Hyperbaric Chamber Operation

PREPARED BY

NAVAL SCHOOL DIVING AND SALVAGE

PREPARED FOR

SERVSCOLCOM, SDIEGO

SUBTRACENPAC, PHARBOR

NAVSCOLDIVSAL, WASH

31 OCTOBER 1975

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INFORMATION SHEET 12-1-1I

TITLE: Hyperbaric Chamber Operation

INTRODUCTION

Having progressed this far in your diving training, you should have come to realize that diving is an exacting and dangerous business. In this regard, we have attempted to, (1) make you aware, or conscious, of the potential for danger - in other words, make you safety conscious, and (2) provide you with sufficient knowledge so that when presented with a potential hazard, you'll know how to react and minimize the danger. The training you have received in Medicine, and the importance placed on medical knowledge throughout the diving community is indicative of the kind of knowledge you should stay abreast of on your diving job.

Needed to complete your medical education is a familiarization with Hyperbaric Chamber operation. The Hyperbaric, or Recompression, Chamber is used to treat diving injuries (decompression sickness, gas embolism) and is invaluable when it's needed. Within this unit, you will receive instruction on the theory of recompression treatment, chamber design and operation. When you successfully complete this unit, you will be able to operate the chamber under the guidance of a diving supervisor - a qualification for Diver, Second Class.

This knowledge, like the chamber itself, is something we hope you never have to use in an actual emergency situation. However, the training you receive and the knowledge you acquire, also like the chamber, will be invaluable should the situation arise when nothing else will suffice.

ASSIGNMENT SHEET 12-1-1A
TITLE: Hyperbaric Chamber Operation

LESSON TOPIC OBJECTIVES

Terminal Objective
1. When the student completes this course, he will be able to, given a diving accident requiring treatment in the Hyperbaric Chamber, perform the functions of an outside Hyperbaric Chamber Operator under the guidance of a diving supervisor.

Enabling Objectives
1. Given a standard print of a Hyperbaric System:

a. Explain, in writing, the functions of the major components in terms of what they do for the system.
b. Describe/Show, by labeling, the physical location of the major components and their component parts.
c. Describe, in writing, the sources of power for the supply piping arrangement and communications components.
d. Orally describe the modes of control.
e. List, in writing, the protective devices for the major components.
f. List, orally, the ratings of the major components.
g. Describe, in writing, the nominal pipe or valve size used throughout the Hyperbaric Chamber System.
h. List, in writing, the major materials used in the major components and their component parts, and explain why.
i. Orally explain how the components and component parts carry out their function(s).
j. Describe, in writing, procedures for pressurization and depressurization of the recompression chamber.
k. Describe, in writing, the administration of HeO2/O2 to the recompression chamber.
l. Describe, in writing, procedures for ventilation of the recompression chamber.
m. Orally state the setpoint(s) and reasons for the setpoint(s) in terms of operating above or below them, for:

(1) The maximum working pressure for the chamber.
(2) Ventilation rate, O2, air.

n. Describe, in writing, the effects on this system due to the air and electrical sources.
o. Orally explain the safety precautions unique to the operation of the Hyperbaric Chamber, to include the following:

(1) Use of fire retardent material inside the chamber.
(2) Release of dogs prior to depressurization of the chamber.

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ASSIGNMENT SHEET 12-1-2A

Enabling Objectives (Cont'd)

2. Under the guidance of the instructor, demonstrate procedures for pressurization of the chamber, checking for leaks, and normal operation of gauges.

3. List situations common to diving, in writing, where the Hyperbaric Chamber would be required for medical treatment.

STUDY ASSIGNMENT

U.S. Navy Diving Manual, Volume I, Paragraph 8.4, Tables 8-4 and 8-5.

STUDY QUESTIONS

1. Complete the following rule regarding recompression treatment:

"The effectiveness of treatment decreases with:

2. Upon reaching the surface following a working dive at a depth of 40 feet, the diver passes out within 3 minutes of being aboard the diving craft. There is no recompression chamber on board. What alternatives are available to the diving superviser?

3. In the case above, which would you personally recommend? Why?

4. List three uses for the recompression chamber other than treatment of decompression sickness and gas embolism.

a.

b.

c.

ASSIGNMENT SHEET 12-1-3A

5. What is the chief advantage of a two-lock recompression chamber over a one-lock chamber?

6. Recompression chambers must be able to achieve and maintain a pressure equivalent of _____ feet (_____ atmospheres absolute).

7. The outside tender has ultimate control of the chamber operation and may, at anytime necessary, override the inside tender's controls.

a. True b. False

8. All gauges must be checked to insure accuracy:

a. before each diving operation.
b. weekly
c. monthly
d. annually

9. How many 200 SCF cylinders would be required for an air supply to maintain a recompression chamber of 400 cubic feet capacity and working pressure of 200 psi?

10. What are the requirements of the secondary air supply of a recompression chamber?

a.

b.

11. The greatest single hazard in the use of a recompression chamber is from _____ _____. Why?

12. What is assumed by the rules on chamber ventilation?

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ASSIGNMENT SHEET 12-1-4A

13. Why is continuous venting of the chamber undesirable?

14. Recompression chambers must undergo a pressure test:

a.

b.

c.

NOTETAKING SHEET 12-1-1N
TITLE: Hyperbaric Chamber Operation

REFERENCES

U.S.Navy Diving Manual, Volume I

NOTETAKING OUTLINE

A. Recompression Chamber Theory

1. Situations Requiring Use of a Recompression Chamber

a. _____ of diver's _____ and _____

(1) _____ sickness

(2) _____ _____

(3) _____ and _____ toxicity

b. _____ _____ Procedures

(1) Using _____

(2) Using _____

(3) _____-_____

c. Equipment _____ and _____

(1) _____ _____ gauges

(2) diving _____

(3) Lifeboat _____ releases

d. Hyperbaric _____ therapy for non-diving injuries.

(1) Gas _____

(2) _____

(3) various conditions producing _____/_____

NOTETAKING SHEET 12-1-2N

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e. Diver Candidate Selection (Pressure and O2 Tolerance)

f. Various aspects of diver training

(1) _____ dives

(2) _____ training

2. Chamber design types and basic operational requirements

a. _____ _____ chambers most common

(1) Made of _____ or _____

(2) Steel double lock chamber

(a) _____ psi working pressure

(b) _____ cubic ft. total volume

1. _____ cubic ft. inner lock volume

2. _____ cubic ft. outer lock volume

(3) Aluminum double lock chamber (designed to replace _____ _____ _____ chambers)

(a) _____ psi working pressure

(b) _____ cubic ft. total volume

(4) Versatile

(a) Possible to treat _____ casualties simultaneously.

(b) Tenders can be _____ and decompressed in the _____ lock during _____ lock treatment.

b. Single Lock Chambers

(1) Few still in use

(2) Made of _____

(a) _____ psi working pressure

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(b) _____ cubic ft. volume

(c) basic disadvantage is not being able to _____ tenders during the treatment.

c. Design Requirements (Navy use)

(1) MEDICAL Lock

(a) about _____ inches in diameter

(b) used to _____ small items _____ or _____ during pressurization of the _____ chamber.

(2) Capable of pressurizing to _____ feet or _____ psig minimum.

(3) Have a primary and secondary _____ _____

(4) Have _____ _____ capability.

(5) Equipped with a _____ _____ and _____ _____ _____ system.

(6) _____

(7) Equipped with _____ on each lock.

3. Air Supply Systems

a. No two alike (except requirement for primary and secondary source)

(1) Primary supply is commonly a _____ of __.__. _____ capable of pressurization up to _____ psig.

(a) Range from _____ to _____ cubic feet internal volume each.

(b) Should contain enough air to pressurize the chamber to _____ pressure _____.

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(2) Secondary Air Supply (commonly a ___.___. _____ _____)

(a) Should be capable of taking chamber to _____ _____ at a rate of _____ FPM minimum.

(b) Usually connected to the chamber through a _____ _____ or _____.

1. Both _____ high pressure

2. _____ _____ can act as an _____ reserve.

3. Used to _____ the pressurized air

(c) Used to _____ the primary air supply.

b. Air supply lines must be painted _____.

c. Exhaust lines must be painted _____ or _____.

d. Air must beet current standards (US Navy Diving Manual)

e. Chamber must be equipped with ___.___. safety _____ set at the proper pressure for the chamber.

4. Chamber Piping System

a. Supply piping is referred to as high pressure from flasks/ compressor to the _____ _____, and low pressure from there to the _____.

(1) High Pressure Piping

(a) Usually made of _____ to _____ thick wall _____ pipe.

(b) Must be tested to _____ psi

(2) Pressure Regulator: _____ HP air to LP air

(a) 3000 psi to _____ psi

(b) _____ point in the system and must be equipped with a _____.

(c) Various manufacturers

(3) Low Pressure Piping

(a) Made from _____ thick wall _____, _____ or _____ pipe.

(b) Tested to _____ psi

b. Exhaust pipe is commonly made of _____ or _____ galvanized _____, _____ or _____

c. Oxygen and Helium-Oxygen Piping

(1) __.___. Piping

(2) Regulators are commonly _____ type

(3) _____ inside the chamber splits gas int) _____ _____.

d. Control Valves

(1) Both _____ and _____

(2) Located _____ _____ in the system to _____ air flow.

e. Color Coded

(1) Exhaust: _____

(2) Air Supply: _____

(3) Oxygen Supply: _____

(4) Helium-Oxygen Supply: _____

NOTETAKING SHEET 12-1-6N

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5. Electrical, Lighting and Communication Systems

a. Must meet strict design and installation requirements

(1) All _____ wiring must be of the _____ duty type, either _____ cable or in _____.

(2) All switches and outlets must be located _____ the chambers.

(3) No _____ or _____ mechanisms that are _____ powered inside the chamber.

b. Chamber illumination - best accomplished by _____ lighting.

(1) Older chambers may have interior lighting that meet these requirments:

(a) _____ proof

(b) permanent

(c) no _____ lighting

(d) Maximum _____ watt light bulb

(2) Portable _____ lights are available.

c. Communications

(1) Primary

(a) Diver's _____ - as in Mk V, inside

(b) Diver's _____, guided radio, or _____ models located outside.

(2) Secondary

(a) _____

(b) Standard _____ _____ _____

6. Helium-Oxygen and Oxygen Supply

a. Gas is kept in standard _____ cubic ft. bottles.

(1) At least _____ bottles per bank.

(2) At least _____ banks of each gas

b. Banks located close to chamber

c. Check _____ prior to commencing _____ operations.

d. Gas to the diver is controlled from _____ the chamber with _____

(1) _____ type

7. Chamber Control System

a. Dual System

(1) "Two-Way"Control:

(2) "One-Way"Control:

b. Two-Way Control has maximum flexibility

(1) _____ tender can control _____ while monitoring passengers/patients.

(a) _____ pressure

(b) _____ depth during treatment

(c) possible _____ intolerance

(2) Upon reaching desired depth, _____ tender can switch to _____ way control.

(a) Inside tender can concentrate of _____.

(b) Burden of _____/_____ is on the outside tender.

NOTETAKING SHEET 12-1-8N

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c. One-way control is for outside tender use in controlling _____.

d. Chamber "stand by" position

(1) Valves are always in standby position when the chamber is _____ _____ _____.

(a) Provides for rapid _____ in the event of an accident.

(b) Position is _____ for all chambers.

(2) Outside the chamber

(a) All one-way valves are _____

(b) All two-way valves are _____

(3) Inside the chamber

(a) All two-way valves _____.

(b) Equalization valves _____.

B. Recompression Chamber Safety and Maintenance

1. _____ _____ _____ increases the possibility of fire and/or explosion.

a. A fire can grow up to _____ times faster than normal

b. Precautions to be taken:

(1) No _____ or _____ _____ materials in the chamber

(a) _____ or _____

(b) _____ materials or any _____ _____

(c) No _____ _____ appliances

(2) Exclude all unnecessary combustible materials

(a) Volatile Hydrocarbon liquids, as:

1. _____

2. _____ or _____ solutions.

(b) _____ or combustible _____ which may combine with _____ under pressure.

(3) Have passengers remove _____ inducing _____ prior to entering the chamber.

(a) _____ _____

(b) _____ or _____

(c) No _____ at anytime

(4) Provide the chamber with flameproof _____

(a) only necessary equipment

(b) No wool or synthetic _____

(5) No _____ fire extinguishers inside the chamber

c. Keep _____ and _____ _____ inside chamber.

d. Keep _____ _____ in full view of occupants.

2. Recompression Chamber Maintenance

a. Included in Planned Maintenance System (PMS)

b. Painting

(1) Only _____ _____ on the inside

(a) _____ old paint

(b) use _____ _____ paint only (FSN 8010-577-4739, or equivalent)

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NOTETAKING SHEET 12-1-10N

(c) Only one coat of primer (FSN 8010-165-8557 TT P-645)

(2) Exterior surface may have one coat of _____ and two coats of _____ or _____

c. Air Systems are also on _____

d. Gauges are checked and tested _____

C. Chamber Operation Technique

1. Pressurization Phase

a. A qualified _____ must be _____ the chamber during any chamber operation.

(1) _____ or _____ Diving Officer

(2) _____ Diver

(3) Diving _____ Officer

(4) _____ Deep Sea Diving _____

(5) _____ or _____ _____ Diver

b. Passengers must remain in an _____, comfortable position.

c. Patients should be in a _____ position, if possible.

d. Hatch is secured with "dogs"

e. The tender ascertains that all riders are "_____ to _____ the _____" and notifies _____ tender. (In case of an emergency, this procedure would be _____)

NOTETAKING SHEET 12-1-11N

f. The inside tender will begin applying _____ to the chamber.

(1) Observe the passengers for any difficulty in _____ pressure.

(2) Any difficulty noted, _____ the descent and _____ _____ up a few feet to allow equalization, then _____. NOTE: If the same individual continually has difficulty, it may become necessary to place him in the _____ _____ for removal rather than aborting the entire run.

g. Rate of descent: normally _____ feet per minute; adjustable according to _____.

h. If patient is to breath oxygen, he should be doing so before _____ _____ _____ on Table ____ or ____.

i. When desired depth is attained, the _____ tender switches the control system to the one-way system by _____ th_____ _____.

j. _____ tender now has operational control of the chamber.

2. Bottom Phase

a. Ventilation

(1) _____ venting is best but has disadvantages

(a) excessively _____

(b) excessively _____ on the air system

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NOTETAKING SHEET 12-1-12N

(2) _____ ventilation is used in accordance with the following requirements:

(a) When air or HeO2 is in use:

1. _____ cubic feet per minute for each _____ at rest.

2. _____ cubic feet per minute for each man _____ at _____. (i.e. tender)

(b) When oxygen is in use, the exhausted _____ is exhausted through the demand mask directly into the chamber _____, which will lead quickly to _____ levels of _____.

1. use _____ cubic feet per minute for each man at rest.

2. use _____ cubic feet per minute for each man not at rest.

(3) Provide standard _____ _____ for each chamber occupant (FSN 2RD-4241-759-3290-LF50). Insure that a _____ _____ has been drilled in each one to prevent _____ _____ _____.

(4) Where O2 levels can be monitored continuously, provide ventilation to keep levels below _____%.

(5) Where calculation of chamber ventilation has not been made:

(a) vent _____ _____ out of _____ when using air

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(b) vent _____ _____ out of _____ when on _____

(c) provide maximum _____ _____ through the chamber when venting with this procedure.

(6) Mechanics of Ventilation

(a) Slowly open _____ _____

(b) Hold depth by opening _____ valve.

(c) Increase the volume of air moving through the chamber by continuing to open the _____, and balancing the _____ with the _____ valve.

(d) Secure the vent by slowly closing both valves, while holding the _____ steady.

b. Before leaving the bottom, insure that the _____ are _____ on the chamber _____.

c. Inform the _____ tender that he is leaving the bottom.

3. Ascent Phase

a. Controlled by the _____ tender.

b. Rate depends upon _____ of chamber.

(1) _____ Treatment Tables: _____ FPM

(2) Air Treatment Tables: _____ minute between stops.

(3) Surface Decompression

(a) O2: _____ FPM

(b) Air: _____ FPM

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NOTETAKING SHEET 12-1-14N

(4) _____ Decompression: _____ FPM

c. Upon arrival at a _____ _____, ventilate the chamber.

4. Time Keeping

a. _____ tender keeps time on all evolutions by using _____ stopwatches.

b. Watches are _____ and _____ at the same time.

(1) Start both watches upon _____ the surface.

(2) Upon reaching the bottom, notify the _____ _____ of descent time and keep watches running.

(3) When leaving the bottom:

(a) _____ and _____ both watches

(b) Notify log keeper of _____ _____, _____.

(4) Control rate of ascent with the _____-_____ _____ _____. NOTE: When ascending at one foot per minute on the _____ Treatment Tables, do not _____ the ascent to balance lost time; stop the ascent, _____, and allow the time to catch up.

(5) Upon arrival at the _____, stop and start the watches, again informing the _____ _____ of elapsed time.

(6) When leaving the stop, again stop and start the watches. Repeat the procedure at each stop.

(7) Upon arriving on the surface, stop the watches and inform the log keeper of ascent time from last _____ to surface.

NOTETAKING SHEET 12-1-15N

5. Log and Records Keeping for Chamber Operations

a. Log must be maintained for recording any event during chamber operations.

(1) _____ treatment

(2) _____ and _____ tolerance tests

(3) _____ decompression

(4) Any other use, including _____ and _____ tests.

b. Must be ACCURATE

(1) _____, _____, _____ of all occupants

(2) _____

(3) Names of all personnel outside the chamber:

(a) _____ tender

(b) _____ supervisor

(c) _____ officer

(d) _____ operators

(e) any other personnel concerned with the operation

(4) _____ record of events

(a) _____, _____, _____ and _____ times.

(b) personnel _____ in and out

(c) time _____ breathing is started and stopped

(d) any information pertinent to the operation

(5) All times are received from the _____ tender or the individual responsible for timekeeping.

(6) The log is an _____ document.

U.S. GOVERNMENT PRINTING OFFICE: 1977 [illegible]

NAVAL SCHOOL DIVING AND SALVAGE

SCUBA Diver A-433-0023

Security Clearance: None

Lesson Topic 1.1 Physical Conditioning

20 Hours

INSTRUCTIONAL MATERIAL:

Student Guides

Standard Classroom Equipment

Physical Training Dress

REFERENCES:

U.S.Army Field Manual FM21-20

Manual of Physical Therapy - Kovacs

TERMINAL OBJECTIVE

1. When the student completes this course he will have achieved and maintained a level of physical conditioning sufficient to allow him to participate, without undue physical stress, in diving training activities.

ENABLING OBJECTIVES

1. During first week of physical training, run continuously for five minutes and perform five repetitions of each of the exercises included in the Instructor Guide.

2. During the second week of physical training, run continuously for ten minutes and perform ten repetitions of each of the exercises included in the Instructor Guide.

3. During the third week of physical training, run continuously for fifteen minutes and perform fifteen repetitions of each of the exercises included in the Instructor Guide..

4. During the fourth week of physical training, run continuously for twenty minutes and perform twenty repetitions of each of the exercises contained in the Instructor Guide.

CRITERION TEST

Each day's physical conditioning period is a series of criterion tests allowing the individual to achieve and maintain the conditioning level of the fourth week's training.

HOMEWORK

Volume A, Student Guide, Information Sheet 1-1-1I; Assignment Sheets 1-1-1A through 1-1-5A

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
1. Introduction to the Lesson.		
A. Establish Contact	Introduce self and topic.	
B. Establish Readiness	Get students ready to learn.	
C. Establish Effect	Bring out the need and value of the lesson.	
D. Overview	State the learning (Terminal and Enabling Objectives.)	
2. Presentation.		Observe and take notes as necessary.
A. Physical fitness.		
1. Anatomical fitness. Possession of all parts and organs essential to diving. This is a function of the Medical Department and is usually done before a man is accepted into the diving program.		
2. Physiological fitness. The diver's capacity for performance and rapid recovery.		
3. To intelligently direct the conditioning of the human body, we must un-		

derstand the way exercise effects the several organs and systems in the body; and, we must know the difference between fit and unfit.

B. The three stages of physical fitness.

1. Toughening stage.

Attaining physical fitness is not an overnight process; the body must go through three (3) stages. The first stage is the toughening stage- it last for about two (2) weeks while the body goes through a soreness and recovery period. (EXPLAIN)

2. Slow improvement stage.

After the body has passed through the first stage of toughening, the next stage is the slow improvement stage. The blood circulation in the muscles increases with exercise, and the body as a whole becomes more efficient physically. The improvement in performance maybe between 6-10 weeks.

3. Sustaining stage.

Prior to this stage the body has reached a level of physical conditioning established by exercises in the first two stages. It is necessary to continue exercising at about the same level to retain the condition developed.

C. Systems of the body affected by exercise: The systems of the body affected by exercise included the skeletal, muscular, circulatory, respiratory and the endocrine system.

1. The skeletal system.

a. Composed of about 206 bones, and furnishes support for the attachment of muscles and protection for the vital organs, such as the brain, lungs, and the heart.

b. Muscle action shapes the bones and protects important joints in the body.

2. Muscular system.

Muscles are of three classifications: Voluntary, involuntary an cardiac. Involun-

rary muscles are those over which we have no control. Voluntary muscles are the larger skeletal muscles which are under control of the individual. Cardiac muscle is found in the heart only, and for all practical purposes is an involuntary muscle. For physical training purposes, with the exception of the heart, voluntary muscles are the most important group.

3. The circulatory system.

   The functions of the circulatory system are to transport blood to all parts of the body, to remove waste products for disposal, and to deliver protecting and repairing substances where needed. The heart, veins, arteries, and capillaries for this system.

4. The respiratory system.

   a. Respiration may be defined as the process of drawing air, or other breathing media into the lungs to supply

oxygen; and to remove CO_2 from the blood.

b. The respiratory apparatus of man consists essentially of the lungs and the air passages leading to them.

c. With exercise, our muscles cells demand and absorb more oxygen and produce more carbon dioxide. This increases the carbon dioxide partial pressure in our blood, thus we breathe faster and deeper during exercises.

5. The glandular system.

a. The body contains several ductless glands which assists to control and regulate the body processes. One of these glands is affected by exercise and is known as the adrenal gland.

b. Action of the adrenal gland. The adrenal gland provides two secretions. Adrenalin enables man to work at a higher level of exercise and

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to feel good while doing it. Competition is frequently one of the best ways to increasing the output of adrenalin.

The second output of the adrenal gland is called Hydrocortisone. This secretion gives one a general sustained level of energy. Individuals who have a high output in this gland are almost super energetic. Since individuals differ in their output of these hormone substances this fact should serve as a guide to be very careful in the application of the overload principle.

c. The theory of "overload" suggests that individuals should not be subjected to undue strain. Hence the necessity for a well co-ordinated physical training program is obvious. It is essential then to plan a regular program and to carry it out. Adjusting it to the

needs of the participants. Better too little than to much, is the key point of the overload principle.

3. Summary - Review.

A. Physical fitness.
B. Three stages of physical fitness.
C. Systems of the body affected by exercises.
D. The overload principle.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
1. Introduction to the Lesson.		
A. Establish Contact	Introduce self and topic.	
B. Establish Readiness	Get students ready to learn.	
C. Establish Effect	Bring out the need and value of the lesson.	
D. Overview	State the learning objectives.	
2. Presentation.		Observe and take notes as necessary.
A. Total fitness for diving includes technical, mental, and emotional fitness. If any of these are lacking, diving effectivess suffers proportionately. Without technical fitness a diver lacks the knowledge and skill to dive; without mental and emotional fitness, he lacks the ability and confidence to dive.		
B. Physical fitness in a diver means a whole and healthy body; the capacity for skillful and sustained performance; the ability to recover from exertion rapidly; the desire to complete a designated task; and the confidence to face an eventaulity.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

C. Benefits of exercise.

1. Muscle tone is improved, and at the same time, muscle strength and endurance are built.

2. Cardio-respiratory endurance or wind, is improved through a process of opening up dormant lung capacity to absorb greater amounts of oxygen.

3. Circulation of blood is speeded and extended to a greater portion of the body as the force exerted by exercises forces the blood to service all parts of the body. The efficiency and effectiveness of the lungs, heart, and blood-vessels is improved.

4. Flexibility is maintained. A wider range of muscular movement is possible; and the ability is developed to accomplish a greater number of physical skills with rapidity.

5. Elimination of body waste seems to gradually become more regulated by long standing exercise program.

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6. Sleep is improved because muscles are healthfully tired after a bout of exercise. A product of sound sleep is a relief of tensions.

7. Eventual control of obesity is possible by using up excessive amounts of fat producing food elements.

8. Susceptibility to injury is reduced through exercise. Muscles, tendons, and joints are strengthened. Injuries such as hernia, back strain, and sprains are less likely to occur if muscles are maintained in proper tone.

9. Confidence is developed by achieving progressively more difficult tasks as physical ability develops.

D. Components of physical fitness.

1. A sound body, free of disease and defect, does not in itself constitute physical fitness. Before a diver can be considered physically fit for diving, he must develop the following traits that are an important part of phy-

sical fitness.

a. Strength - Every diver needs enough strength to perform the heaviest task he may encounter in routine and emergency activities. Muscles increase in size, strength and firmness with equal exercise. Without work, they grow flabby and weak.

b. Endurance - Each diver needs sustaining power to maintain his performance without undue fatigue. There are two types of endurance.

1. Muscular endurance-Muscular endurance is characterized by the ability to perform continuous work over long periods of time.

2. Cardio respiratory endurance -The development of wind endurance is necessary to maintain muscular endurance. The maximum effort a man can exert over a period of time is limited by his capacity to absorb oxygen and expel carbon dioxide.

c. Agility. A diver must be able to change direction quickly, and as

faultlessly as possible. The ability to react instantly, & to maintain orientation during rapid changes of body positions, may save his life.

d. Coordination. This is the ability to move all parts of the body in a smooth, efficient, & concerted effort. A well coordinated diver does not make useless movements. He moves with precision and accuracy; and thus, saves energy.

E. Principles of physical conditioning.

1. Progression: Gradual progression from a low state of fitness to a higher state is possible through application of a progressive program.

2. Regularity. There is no easy or occasional way to develop physical fitness. Regularity of exercise is a must, with daily exercise preferred.

F. Warm-up and cool-off period. It's a fundamental physiological principle that man should warm up gradually before taking strenous exercise. After exercising, one should keep active by

walking or performing some other muscular activity until breathing and temperature have returned to normal; thus ending the cool-off period.

3. Summary - Review.

A. The need for physical training in diving.

B. The benefits of physical training.

C. The components of physical fitness.

D. The principles of physical fitness.

MEMORANDUM

From: Training Department
To: All Students

Subj: Physical Fitness

DAY I. Classroom - First of two topics on physical fitness.
TITLE: The Body and Physical Fitness

DAY II. Classroom - Second of two topics on physical fitness.
TITLE: Concept of Developing Physical Fitness

DAY III. Start Physical Fitness Training in morning with all other students.

STANDARDS: 1. The first week the student performs a minimum of five repititions per exercise (see attached sheets), and continuous running for five minutes.

2. The second week should show progression to ten repitions per exercise and continuous running for ten minutes.

3. The third week should show progression to fifteen repitions per exercise and continuous running for fifteen minutes.

4. The fourth week, the student should reach the peak of his conditioning and be able to perform twenty repitions per exercise and run continuously for twenty minutes.

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BODY STRETCHER

V UP AND TOUCH

SIT UPS

FRONT BACK BENDER

TRUNK TWIST

WHEN DONE ENTHUSIASTICALLY, THE EXERCISES SHOWN ABOVE SHOULD INCREASE ABDOMINAL STRENGTH AND FLEXABILITY.

CAUTIONS: WHEN PERFORMING V UP AND TOUCH, FLEX NECK AS 1st MOTION IN PERFORMING THE EXERCISE.

Leg lift and body twist

Hello Darling

Flutter kick

Leg lifts

When properly executed these exercises should build back strength, and increase over all muscle tone primarily in the back muscles.

CAUTIONS: Hello Darlings - Always flex neck so that chin touches chest. This is done to prevent low back strain.

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EIGHT (8) COUNT BODY BUILDER

PUSH UPS

MOUNTAIN CLIMBER

STEAM ENGINE

PURPOSE: THESE EXERCISES ARE INTENDED TO BUILD STRENGTH IN THE ARMS, SHOULDER GIRDLE MUSCLES AND ABDOMINAL: AND INCREASE OVERALL FLEXABILITY.

METHODS: Pushups and 8 count body builder.
(a) Inhale on bringing chest to ground; exhale when pushing.
(b) Touch chest to the ground.
(c) Back strength.

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PROPER RUNNING FORM

THE ENDURANCE RUN IS INTENDED TO BUILD CARDIO-RESPIRATORY ENDURANCE

NAVAL SCHOOL DIVING AND SALVAGE

SCUBA Diver A-433-0023

Security Clearance : None

Lesson Topic: 2.1 Decompression Charting

20 Hours

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual, Vol. I

Student Guide

Standard Classroom Equipment

Overhead Projector

Transparencies

TERMINAL OBJECTIVES

1. When the student completes this course he will be able to, given the following diving situations:

   a. Normal working dive to include depth, job performed, bottom time and water decompression.

   b. Normal working dive to include depth, job performed, bottom time and surface decompression, air.

   c. Normal working dive to include depth, job performed, bottom time, and surface decompression O2.

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TERMINAL OBJECTIVES(CON'T)

Perform necessary computations correctly, select proper descent/ ascent rates, select proper decompression schedules and, using the information, complete the Diving Chart and, if applicable, Repetitive Dive Worksheet.

ENABLING OBJECTIVES

1. Decompression Schedules

   a. List the name of each table in air and O2 decompression.

   b. Explain the application of the repetitive dive work sheet, recompression chamber, breathing medias, depth guages, and time pieces.

   c. Describe how the use of various diving equipment affects decompression.

   d. Define selected terms as used in air decompression.

   e. Describe the sequence of computation for determining the decompression schedule for a repetitive dive.

   f. Describe the sequence of computation for determining the selection of the proper decompression schedule and the rate of ascent to the first stop.

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ENABLING OBJECTIVES (CON'T)

g. Explain the need for decompression and decompression schedules.

h. Explain the limits imposed by the utilization of oxygen for decompression.

i. Describe the conditions under which the need for additional decompression other than that computed would be used.

j. Describe the fundamentals involved in decompression when high altitude diving.

k. Describe the most vital requirements of breathing media composition, depth and time.

l. Describe the basic types of decompression tables.

2. Navy decompression Tables (Air) System

a. Given the following:

(1) Decompression procedures

(2) Standard Air Decompression Schedules

(3) No-Decompression Limits

(4) Surface Interval Credit

(5) Repetitive Dive Time Table

(6) Exceptional/Extreme Exposure

(7) Surface Decompression using O2

(8) Surface Decompression using air

(9) Nitrogen-Oxygen Equivalent Air Depth Table

(10) Nitrogen-Oxygen Equivalent Exceptional Exposure

(11) Oxygen Depth Time Limits

(12) Diving Charts

(a) Explain the function(s), source of information required for use, application or use, and a description of the component.

(b) Describe the physical location of each component part within the major component and explain the application or use of the component part.

(c) Describe how each component contributes to the control accomplished by the use of decompression schedule system.

(d) Work a dive using the Standard Decompression Schedule.

(e) Work a repetitive dive using the repetive dive worksheet.

(f) Work a surface decompression dive using oxygen.

ENABLING OBJECTIVES (CONT'D)

(g) Work a surface decompression dive using air.

(h) Describe the use of the Nitrogen Air Equivalent Depth Table.

(i) Describe the use of the Oxygen Partial Pressure and Oxygen Depth Time Limits.

(j) Given the maximum depth/ time limits for each component and the maximum partial pressure limits, state the setpoint(s) and the reason for the set-point(s) in terms of the effects of operating above or below them.

CRITERION TEST

Given the following diving situations:

Normal working dive to include depth, job performed, bottom time and water decompression.

Normal working dive to include depth, job performed, bottom time, and surface decompression.

Normal working dive to include depth, job performed, bottom time and surface decompression, O2.

CRITERION TEST (CONT'D)

Perform necessary computations correctly, select proper descent/ ascent rates, select proper decompression schedule and, using the information, complete the Diving Chart and, if applicable, Repetitive Dive Worksheet.

HOMEWORK

Volume A, Student Guide

Day 2 - Assignment Sheets 2-1-9A thru 2-12A
Day 3 - Assignment Sheets 2-1-13A thru 2-1-26A

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
PRESENTATION:		
I. Air Decompression		
A. Discussion: Nitrogen absorption during a dive is directly related to the partial pressure of the inspired nitrogen, with particular emphasis on depth and time duration. To prevent the development of decompression sickness, special tables have been established. These tables take into consideration the amount of nitrogen absorbed by the body tissues exceeds a certain critical amount. The divers ascent must be delayed to allow the removal of excess nitrogen through normal metabolic	BE VERY DELIBERATE AND POSITIVE DURING DISCUSSION.	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
processes. Decompression sickness results from failure to delay the ascent and to allow this process of gradual desorption to take place.		ALL DEFINITIONS ARE CONTAINED IN READING ASSIGNMENT.
B. Definitions:		
1. Single Dive - Any dive conducted after 12 hours of a previous dive.		
2. Repetitive Dive - Any dive conducted within a 12 hour period of a previous dive.		
3. Depth - When used to indicate the depth of a dive means the maximum depth attained during the dive. Measured in feet of sea water.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
4. Dive Schedule - Specific decompression procedure for a given combination of depth and bottom time. As listed in the decompression table; Normally indicated in feet and minutes.		ALL DEFINITIONS ARE CONTAINED IN READING ASSIGNMENT
5. Decompression Stop - Specified depth at which a diver must remain for a specified length of time to eliminate inert gases from his body tissues.		
6. Surface Interval - The time which a diver has spent on the surface following a dive; beginning as soon as the		

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diver surfaces and ending as soon as he starts his next descent.

7. Residual Nitrogen - Nitrogen gas, that is still dissolved in a diver's tissues after he has surfaced.

8. Repetitive Group Designator - A letter which relates directly to the amount of Residual Nitrogen in a diver's body for a 12 hour period after a dive.

9. Residual Nitrogen time - An amount of time, in minutes, which must be added to the bottom time of a repetitive dive to compensate for the nitrogen still in solution in a diver's tissues from a previous dive.

10. Equivalent single dive time - A single dive for which the bottom time is the sum of residual nitrogen time, and actual bottom time of the planned repetitive dive.

11. Single Repetitive Dive - A dive for which the bottom time used to select the decompression schedule is the sum of the residual nitrogen time and the actual bottom time of the dive.

C. Diving Records Abbreviations

1. LS - Left Surface
2. RB - Reached Bottom
3. LB - Left Bottom
4. R - Reach a stop

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

5. L - Left a Stop

6. RS - Reach Surface

7. TBT - Total Bottom Time

   a. Computed from leaving surface to leaving the bottom

8. TDT - Total decompression time.

   a. Computed from leaving bottom to reaching surface.

EMPHASIZE

9. TTD - Total time of Dive.

   a. Computed from leaving the surface to reaching the surface.

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D. Table Selection

1. The following are decompression tables

   a. USN Standard Air Decompression Table

b. No Decompression limits and Repetitive Group designation table

c. Surface decompression table using oxygen

d. Surface decompression table using air.

2. Each decompression table has specific conditions which justify it's selection. These conditions are basically depth and duration of the dive to be conducted, availability of a recompression chamber, availability of an oxygen breathing system within the chamber, and the specific environmental conditions, such as sea state, water temp., etc.

3. The residual nitrogen time table for repetitive air dives provides

information relating to the planning of repetitive dives.

4. Ommitted Decompression - An emergency situation requiring recompression treatment. (discussed in greater detail in Chap. 8)

5. Equipment: If available, use a diving stage for all in water decompression. Plan SCUBA dives to eliminate the need for decompression. If decompression is necessary in SCUBA, tenders must rig a descending line with markers to identify the required decompression stops depths.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
E. General Use of Decompression Tables		
1. Rate of Descent		
a. 75 FPM		
b. Rounded off to next greater whole minute		
2. Rate of Ascent		
a. 60 FPM (except Sur-D O2 Table)		
F. Variations in Rate of Ascent	EMPHASIZE, & REPEAT UNTIL	
1. Condition - Rate of ascent less than 60 FPM, delay occurs greater than 50 FSW	ALL QUESTIONS ARE CLEAR	
a. Procedure - Increase bottom time by adding to it the total time of delay.	BEFORE MOVING ON TO NEXT TOPIC.	
b. Decompress according to new total bottom time.		
2. Condition - Rate of ascent		

less than 60 FPM, delay occurs less than 50 FSW

a. Procedure - Increase the first stop by the amount of delayed time.

3. Condition - Rate of ascent greater than 60 FPM, No decompression required, bottom time places diver within 10 mins. of decompression schedule requiring decompression.

a. Procedure - Stop at 10 ft. for the amount of time gained.

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4. Condition - Rate of ascent greater than 60 FPM, decompression required.

a. Procedure - Stop 10 ft. below first scheduled water

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
stop, for amount of time gained.		
G. Oxygen use During Decompression		
1. Oxygen decompression provides significant savings in decompression time as compared to other breathing medias.	*SHOW AND REVIEW O2 P/P Limits & O2 Depth time limits. State set points.	
2. Oxygen partial pressure limits must not be exceeded if symptoms of oxygen toxicity are to be avoided.		
3. No work is performed by diver when decompressing on oxygen.		
H. Selection of Decompression Schedule.		ASK QUESTIONS
1. Schedules for all tables are given in 10 ft. depth increments.		
2. Bottom times for all schedules are usually in 10 min. increments.		
3. Depth and total bottom time combinations form actual dives.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
4. Always select exact or next greater depth.		
5. Always select exact or next greater time.		
6. Do not interpolate between decompression schedules.		
7. Do not alter or modify decompression schedules without prior approval of a diving medical officer.		
8. Diver's chest should be located as close as possible to the stop depth.		
9. Decompression stop times begin when the diver reaches the stop depth.		
10. Do not include ascent time as part of stop time.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
11. If the diver was exceptionally cold or showed signs of extreme fatigue druing the dive, or if his work load was relatively strenuous, the next longer decompression schedule should be selected. This exception effects total bottom time only, retain same depth schedule.	EXCEPTION!!!	
I. Exceptional Exposure		ASK QUESTIONS
1. Exceptional exposures are shown in red on the USN standard air decompression table.		
2. To be used for exceptional or emergency cases only.		
3. No repetitive diving following decompression for exceptional exposure.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
4. Use of exceptional exposure schedules requires the authorization of the Diving Officer.		
J. Repetitive Dives		ASK QUESTIONS
1. Any dive performed within 12 hours of a previous dive is a repetitive dive.		
2. The period between dives is the surface interval.		
a. 12 hour maximum		
b. 10 mins. minimum		
3. Decompression following a repetitive dive requires special consideration due to the residual nitrogen from the previous dive at the beginning of the repetitive dive.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
4. Refer to repetitive group designator assigned by either standard air table or no decompression table.		
5. Determine residual nitrogen time by using residual nitrogen time table for repetitive air dives.		ASK QUESTIONS
6. Determine equivalent single dive time a. Residual nitrogen time and total bottom time = equivalent single dive time.		
7. Decompression schedule is selected according to new equivalent single dive time.		
8. Equivalent single dive times which require the use of exceptional exposure decompression schedules, should		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

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whenever possible be avoided.

9. If still another repetitive dive is to take place, the equivalent single dive time from the first repetitive dive should be used to determine proper schedule selection.

ASK QUESITONS

K. Surface Decompression

SEE REPET. FLOW CHART FIG. 7 - 1

1. Definition: A technique for fulfilling all or a portion of the diver's decompression obligation in a recompression chamber, rather than in the water. This procedure is especially desirable under the following

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conditions:

a. To provide comfort and security for the diver when one or more of the following conditions exist.

(1) Extremely cold conditions

(2) Rough sea state

(3) Physical exhaustion and etc.

2. Advantages of surface Decompression

a. Shorter exposure time in water.

b. Maintainence of constant pressure level (depth control)

c. Close observation

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
3. There is no surface decompression schedule for use following an exceptional exposure dive.	SHOW TRANSPARANCY	
4. No repetitive diving is allowed following surface decompression		
II. Air Diving Tables		
A. USN Standard Air Decompression Table and exceptional exposure table.		
1. Maximum depth and time limits 190'/:60		
2. The exceptional exposure schedules are printed in red.		
3. All schedules must be rigidly followed to insure maximum diving safety.		
4. Normal limits are not exceeded without prior approval		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
of Diving Officer.		
6. Obtain repetitive Group designator from last column reading horizontally across.		
7. If no decompression dive, obtain repetitive group designator from no decompression table.		
8. No repetitive group letters are listed for exceptional exposures.	WORK EXAMPLE INTRODUCE DIVING CHART	ASK QUESTIONS
9. Maintain good depth control	SHOW TRANSPARANCY	*STUDENTS COPY EXAMPLE
10. Rate of ascent between stops not critical between stops less than 50 FSW. Delay greater than 50 FSW could result in excessive nitrogen absorption.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
B. No decompression limits and repetitive group designation table for no decompression air dives.		
1. Provides group designator for no decompression dives only, should diver make a repetitive dive.		ASK QUESTIONS
2. Each depth listed has corresponding no decompression time limits given in minutes. This is the maximum amount of time a diver may spend on the bottom and surface without decompression.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
3. Use the exact or next greater depth and total bottom time.		
4. To find repetitive group designator:		
a. Enter table on exact or next greater depth of exposure, follow that line to the right to the bottom time equal to or next greater than bottom time of the dive.		ASK QUESTIONS
b. The group letter is located at the head of the vertical column reading upward.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
C. Residual Nitrogen Time Table for Repetitive Air Dives		
1. Surface interval time are expressed in hours and mins.		
2. Each interval has two limits		ASK QUESTIONS
a. Maximum light (top) not to exceed 12 hours.		
b. Minimum limit (bottom) at least 10 mins.	851	
3. Find repetitive group letter from previous dive on diagonal slope.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
4. Enter table horizontally to select the appropriate interval.		
5. Read downward to bottom of table to obtain new repetitive group letters.		
6. Residual nitrogen times, corresponding to the depth of the repetitive dive are given in the lower portion of the table.		ASK QUESTIONS
7. Continue reading downward from repetitive group letter to the row which represents the depth of the repetitive dive.	EMPHASIZE WORK EXAMPLE INTRODUCE REPT. DIVE WORKSHEET	STUDENTS COPY EXAMPLE
8. The time shown at the intersection is the residual nitrogen in minutes to be applied to the repetitive dive.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
9. There is one exception to this table, in some instances, when the repetitive dive is to the same or greater depth than the previous dive, the residual nitrogen time may exceed the actual bottom time of the previous dive. In this event use the actual total bottom time of the previous dive as the residual nitrogen time in determining equivalent single dive time.		
D. Surface Decompression Table Using Oxygen	SHOW TRANSPARANCY	ASK QUESTIONS
1. Depth and time limits 170/40		
2. Rate of descent 75 FPM		
a. Rounded off to next greater whole min.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
3. Rate of ascent a. Water Stops: Use 25 FPM to first water stop, one min. between stops, and one min. for ascent from 30 ft. water stop to surface. b. No water Stops: Use 25 FPM rate of ascent to surface. Round off to next greater whole min.		ASK QUESTIONS
4. Surface Interval a. Must not exceed five minutes (1) Time from 30 ft. water stop - one min. (30 FPM) (2) Time to land diver on deck and undress diver. 3 mins. 30 seconds		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(3) Time to descend in recompression chamber to 40 ft. 30 seconds (80 FMP)		
5. Surfacing in Recompression Chamber		
a. Diver breathes oxygen continuously and without interruption during the 40 ft. chamber stop. Vent Chamber regularly.		
b. Take two additional mins. to surface with diver still on oxygen. (rate of ascent 20 FPM)		ASK QUESTIONS
6. Total Decompression Time		
a. Includes all times from leaving the bottom to reaching surface the second time.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
b. This time may be shortened only by decreasing the amount of time required to undress the diver on deck.		
7. Oxygen breathing		
a. Diver goes on oxygen immediately upon entering chamber.		ASK QUESTIONS
b. Must have good mask fit - no leaks permitted		
c. Oxygen breathing time starts upon reaching 40 ft. chamber stop.		
d. Diver remains at rest throughout oxygen breathing period.		
8. In event of oxygen toxicity symptoms or failure of oxygen		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
supply, give decompression in accordance with surface decompression air table - disregard all time spent on oxygen.		
	WORK EXAMPLE	ASK QUESTIONS
	SHOW TRANSPARANCY	STUDENTS COPY EXAMPLE

E. Surface Decompression Table Using Air

1. Maximum depth and time 190/60
   a. Used when maximum limits for surface decompression using oxygen are exceeded.
   b. O2 Failure
   c. O2 Toxicity Symptoms
2. Rate of descent
   a. 75 FPM (water) rounded to next greater whole min.
   b. 60 FPM (chamber)

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
3. Rate of Ascent		
a. 60 FPM - This rate is used to first water stop, between stops, and to the surface in the water and chamber.		
4. Surface Interval		
a. Time of ascent from last water stop		
(1) last stop can be 10 ft. or 20 ft. (60 FPM)		ASK QUESTIONS
b. Time for landing diver on deck and undressing diver.		
(1) Not to exceed 3 mins. 30 seconds.	WORK EXAMPLE	STUDENTS COPY EXAMPLE
c. Time to descend to first chamber stop		
(1) Can be 10 ft. or 20 ft.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

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5. Total Decompression Time

a. Included all times from leaving bottom to reaching surface the second time.

b. This time may be shortened only by decreasing the time required to undress the diver on deck.

ASK QUESTIONS

F. Nitrogen-Oxygen SCUBA Tables

1. The fundamental principle of decompression from nitrogen-oxygen dives is the establishment of an equivalent air depth.

SHOW N2-O2

TABLE - WORK EXAMPLE

STUDENTS COPY EXAMPLE

2. The equivalent air depth is that depth at which the partial pressure of

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
nitrogen in the breathing bag.		
3. Using equivalent air depth and the actual bottom time of the dive, the decompression schedule to be used is selected from the USN Standard Air Decompression Table.		ASK QUESTIONS
4. The nitrogen-oxygen SCUBA Tables provides equivalent air depths for non-swimming and swimming dives. Mixes of 60%, 40% and 32.5% oxygen are used.	SHOW N2-O2 TABLE WORK EXAMPLE	STUDENTS COPY EXAMPLE
5. Maximum allowable bottom times for these dives are controlled by the exposure limits of oxygen partial pressure limits table.		

6. Exceptional Exposures are to be used in emergency situation only, and must be authorized by the commanding officer of the diving facility involved.

7. Non-swimming dive flow settings are required in ordnance disposal to avoid excessive sound production in the water.

G. Nitrogen-Oxygen Repetitive Dive Procedure

1. Using the equivalent air depth, obtain repetitive group letter from standard air table or no decompression table.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. Determine equivalent air depth for repetitive dive.		
3. Compute for repetitive dive according to previous instructions for repetitive air diving.		ASK QUESTIONS
4. Omitted decompression should be treated as an emergency.	WORK EXAMPLE PLACE ON CHALKBOARD	
5. Surface decompression tables can only be used if the emergency surface interval occurs at such a time that water stops are not required or have already been completed according to whichever table is considered most appropriate.	EXCESS N2 ALLOWED ALT DEPTH	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

H. Decompression and Altitude Diving

1. Standard Air Decompression Tables are not safe for altitude diving.

   a. Before start of dive N_2 dissolved than at surface

   b. N_2 dissolved at end of dive at altitude.

   c. Body tolerates N_2 at altitude.

   d. EDU Report 6-65 will allow calculation by qualified diving med. officer.

   e. Only tables in circulation are private property of Dr. ALBERT BUHLMANN Kantons Hospital Zurick, Switzerland.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

SUMMARY

I. Air Decompression

A. Definitions

1. Single
2. Repetitive Dive
3. Depth
4. Dive Schedule
5. Decompression Stop
6. Surface Interval
7. Residual Nitrogen
8. Repetitive Group Designator
9. Residual Nitrogen Time
10. Equivalent Single Dive Time
11. Single Repetitive Dive

B. Diving Record Abbreviations

1. LS
2. RB
3. LB
4. R-
5. L-

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

6. RS

7. TBT

8. TDT

9. TTD

C. Table Selection

D. General Use of Decompression Tables

1. Rate of ascent

2. Rate of descent

3. Variations in rate of ascent

E. Oxygen use during decompression

F. Selection of decompression schedule

G. Exceptional Exposure

H. Repetitive Dives

II. Surface Decompression

III. Air Diving Tables

A. USN STandard Air Decompression Table and exceptional exposure table.

B. No decompression limits and repetitive group designation table for no decompression air dives.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
C. Residual nitrogen timetable for repetitive air dives.		
D. Surface decompression using oxygen		
E. Surface decompression using air		
F. Nitrogen-Oxygen SCUBA Tables		
G. Nitrogen-Oxygen repetitive dive procedures		
H. Decompression and altitude diving.		

SCUBA Diver A-433-0023

Security Clearance: None

Lesson Topic: 2.1 Decompression Charting
2.2 Diving Formulas

4 Hours

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual, Vol. I

Student Guides

Standard Classroom Equipment

Films #NAVMED 8749 A&B

Transparencies

Movie Projector

Overhead Projector

TERMINAL OBJECTIVE

1. When the student completes this course, he will be able to , given the following diving situations:

   Normal working dive to include depth, job, bottom time and water decompression. Normal working dive to include depth, job, bottom time and surface decompression. Normal working dive to include depth, job, bottom time and surface decompression, 02.

   Perform necessary computations correctly, select proper descent/ascent rates, select proper decompression schedule and, using the information, complete the Diving Chart and, if applicable, Repetitive Dive Work Sheet.

2. When the student completes this course, he will be able to, given a diving situation and a sheet containing formulas used in diving, select the applicable formula(s) and solve the problem posed in the situation.

ENABLING OBJECTIVES

1. DEFINE and DESCRIBE, in writing, terms used in Diving Physics.

2. DESCRIBE, in writing, the following as to how they affect the diver underwater:

   a. Boyle's Law

   b. Charles' Law

   c. Dalton's Law

   d. Henry's Law

ENABLING OBJECTIVES (CONT'D)

e. Heat Transfer

f. Sound Transmission

g. Light Refraction

3. Orally EXPLAIN the application and use of all diving formulas.

CRITERION TEST

None

HOMEWORK

Volume A, Student Guide, Assignment Sheets 2-1-1A through 2-1-8A

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
INTRODUCTION TO THE LESSON:		
1. Establish contact	1. Introduce self and topic.	
2. Establish readiness	2. Get students ready to learn. Create interest.	
3. Establish effect	3. Bring out need and value of the lesson.	
4. Overview	4. State the Terminal Objective and, briefly, the Enabling Objectives.	
PRESENTATION:		TAKE NOTES AS DEEMED NECESSARY.

1. BASIC CONCEPT OF MATTER:

   a. Physics is the science of matter and energy and their interactions.

   b. Matter is the substance of which the universe is composed.

   c. Energy is the force which work upon and within the substance.

   d. An element is the simplist form of matter which exhibits distinct physical and chemical properties, and cannot be broken up into other, more basic forms by chemical means.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

e. The Atom is the smallest particle of matter which carries the specific properties of an element.

f. Molecules are formed from groups of atoms, and usually exhibit different properties than any of the contributing atoms.

g. THE THREE STATES OF MATTER:

1. Solids - Have definite weight, shape, and volume.

2. Liquids - Have definite volume and weight, but take the shape of their container.

3. Gases - Have definite weight and occupy space, but lacks definite volume or shape.

h. The state in which a particular substance exists depends upon two factors:

1. Principally, Temperature

2. Partially, Pressure

2. UNITS OF MEASUREMENT

a. The metric system is currently used in almost every country in the world except the English speaking ones, and it is widely

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

used throughout the scientific community.

1. The principle unit of length is the meter.

   a. one meter = 39.37 ins.

   b. 1000 meters = 1 kilometer (about .64 mi.)

   c. For measuring smaller lengths millimeter (mm) or centimeter (cm) are used.

2. The metric system uses its units of length squared to measure area.

   a. One square meter = 10,000 sq. cm.

3. Units of volume are units of length cubed.

   a. 1,000 cubic centimeter = 1 liter (1,000 cc)

   b. 1 liter = 0.001 cubic meters.

4. The kilogram is the standard metric unit of weight and mass. For smaller masses the gram and milligram are used.

   a. 1000 gms = 1 kilogram = 2.2 pounds

   b. 1000 milligrams = 1 gram

5. The most commonly used metric unit of pressure is kilograms per square centimeter. (kg/cm2)

EMPHASIZE

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

b. Fahrenheit and celsius temperature scales.

1. Countries that use the English system generally employ the fahrenheit scale. Water boils at 212°F and freezes at 32°F.

2. Countries that use the metric system, and most scientific laboratories, use the celsius scale. Water boils at 100°c and freezes at 0°c.

3. Conversion of Temperature Scales

a. Fahrenheit to Celsius — WORK EXAMPLE

C=5/g (F-32)

(1) Substract 32 from F° reading.

(2) multiply the result by 5/9.

b. Celsius to Fahrenheit — WORK EXAMPLE

F=(9/5XC) + 32

(1) Multiply 9/5 X c reading

(2) Add 32 to the result.

c. Heat energy is measured in BTU's or calories.

1. BTU - British Thermal Unit - is the amount of heat needed to raise the temperature of one pound of water one degree fahrenheit.

2. A calorie is the amount of heat required to raise one gram of water one degree celsius.

d. Heat transfer is accomplished by one of three methods, or by a combination of them.

1. Conduction is the direct transmission of heat from molecule to molecule, or through materials that are in direct contact with each other.

2. Convection is the transmission of heat by the movement of a liquid or a gas, as in an auto engine.

3. Radiation is the transmission of heat by ELECTROMAGNETIC WAVES of ENERGY. Heat from the sun, electric heaters, and fireplaces are primarily radiant heat.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

3. Pressure in Diving

a. Key Points

1. Pressure is defined as a force acting upon a particular area of matter. It is measured in pounds per square centimeter in the metric system (KG/cm2)

2. Force is push or pull measured in pounds.

3. Area is the surface that force is exerted upon.

4. Any diver, at any depth, must be in pressure balance with the forces at that depth.

5. Any consideration of pressure must always be thought of in terms of attaining and maintaining pressure balance.

b. Types of Pressures

1. Atmospheric: The pressure of the atmosphere, considered to be constant at sea level, and acts on all things in all directions. At sea level the atmosphere weighs 14.7 psi or 1 KG/cm2.

2. Gage: Pressure exerted on any submerged object. Gage pressure is zero at sea level, and is measured in psig.

3. Barometric: Essentially the same as atmospheric but varying with weather conditions, expressed in terms of the weight of a column of mercury (standard pressure 29.92 ins. of mercury or 760 millimeters of mercury. (mmhe)

4. Absolute: The total pressure being exerted, gases plus one atmosphere. Measured as pounds per square inch absolute psia/

4. The composition of dry air

a. Component percent by volume

1. Nitrogen	78.084
2. Oxygen	20.946
3. Carbon Dioxide	.033
4. Rare gases	
a. Neon	
b. Helium	.003
c. Krypton	

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
d. Hydrogen		
e. Xenon		
f. Radon .003		
g. Carbon Monoxide		
5. Commonly Simplified as:		
a. Nitrogen 79		
b. Oxygen 21	EMPHASIZE	
b. Oxygen (02)		
1. Exists freely in diatomic state.		
2. Colorless, odorless, and tasteless.		
3. Readily combines with other elements.	EMPHASIZE	
4. Only gas that can sustain life.		
5. 16% minimum required to sustain life at sea level.		
6. Prolonged exposure to oxygen is harmful to the body.		
7. Supports combustion, but does not burn, matter can not burn unless oxygen is present.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
C. Nitrogen (N2)		
1. Physiologically inert.		
2. Colorless, ordorless, and tasteless.		
3. Nitrogen narcosis is a disorder resulting from the anesthetic properties of nitrogen breathed under pressure. Can result in a loss of orientation and judgement by a diver.	EMPHASIZE	
D. Helium (HE)		
1. Exists in a monatomic state.		
2. Colorless, odorless, and tasteless.		
3. Almost totally inert and insoluble in water.	EMPHASIZE	
4. Seven times lighter than air.		
5. Used in diving to eliminate nitrogen narcosis in deep diving operations.		
6. Disadvantages		
a. Voice distortion - Donald Duck Effect.		
b. High thermal conductivity.	(9)	

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

E. Hydrogen (H2)

1. Exists in diatomic state.

2. Colorless, odorless and tasteless.

3. Rarely found in free state on earth, but very abundant in the rest of the Universe, the sun and stars are almost pure hydrogen.

4. Lightest of all elements.

5. Violently explosive in the presence of more than 5.3% oxygen.

6. Hydrogen has been used in diving, but the hazards have limited its use to little more than experimentation.

F. Neon (NE)

1. Exists in a monatomic state.

2. Colorless, odorless, and tasteless.

3. Good conductor of electricity at very low pressures.

4. Glows with distinctive orange-red color.

5. Has been used experimenting in diving.

G. Carbon Dixoide (CO2)

1. Exists in a diatomic state.

2. Colorless, odorless, and tasteless in low percentages, has an acid taste and odor in greater concentrations.

3. Natural by-product of respiration.

4. For divers the two main concerns with CO2 are control of the quantity in the breathing supply, and removal of the exhaust after breathing.

5. In high concentrations CO2 can be extremely toxic.

H. Carbon Monoxide (CO)

1. Exists in a monatomic state.

2. Does not occur in quantity in the air.

3. Most commonly found in the exhaust of internal combustion engines.

4. Highly poisonous to man.

5. Odorless, colorless, and tasteless.

I. Water Vapor (H2O)

1. Air contains water vapor which is considered a gas, and is responsible for humidity in the divers air.

2. Problems from too much water vapor in divers air supply.

a. Fogged up face plate.

b. Frozen air-lines.

c. Chilling of body.

3. Problems from too little water vapor in divers air supply.

a. Irritated sinuses

b. Irritated throat.

c. Dried out gaskets in pumps and air-lines.

5. Gas laws

A. Kinetic theory of gases.

1. The basic explanation of the behavior of gases under all variations of temperature and pressure is known as the kinetic

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

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theory of gases.

2. Two factors related to kinetic theory

   a. Molecular speed - A temperature function.

   b. Gas weight - Type gas function.

   c. A change in one of these factors, must result in some measureable change in the other factors.

3. The kinetic energy of any gas at a given temperature is the same as the kinetic energy of any other gas at the same temperature, consequently the pressures of all gases resulting from kinetic energy are affected by the same factors.

B. Boyle's Law - Pressure-Volume Relationship (P/V)

INST. Show & Tell

ST. Listens, take notes, ask questions.

Pi Vi=P2 V2

P=Absolute Pressure
V=Volume
1=1st state of container
2=2d state of container

1. If the temperature remains constant, the volume of a gas will vary inversely as the absolute pressure, while the density will vary directly as the pressure.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. Deals with a. Squeezes b. Air embolism		
3. Pressure increase-Volume decrease-squeeze results, if descent is uncontrolled		
4. Pressure decrease-Volume increase results in air embolism if uncontrolled on ascent.		
5. Density increases directly with pressure up to a point, at deeper depths density increase slows down, but generally, if the pressure on a gas is doubled, the density is doubled.		
C. Charles' Law-Temperature-Volume Relationship	INST. Show & Tell	ST. Listens, take notes ask questions.
1. If the pressure is kept constant, the volume of a gas will vary directly as the absolute temperature.	$\frac{V1}{T1} = \frac{V2}{T2}$ T=Absolute Temp. Add 460° to temp. reading for F° absol. Add 273° to temp. reading for C° Absol.	
2. Deals with a. Charging SCUBA bottles b. Mixing & analyzing breathing medias.		

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c. Recompression chamber operations.

3. Volume increases with temperature increase.

4. Volume decrease with temperature decrease.

NOTE: It follows that if volume rather than pressure is kept constant, the absolute pressure will increase in proportion to the absolute temperature.

D. General Gas Law - Combination of Boyle's and Charles' Laws

1. Boyle's and Charles demonstrated that with any gas the factors of temperature, volume and pressure were so interrelated that a change in any of these factors must be balanced by a corresponding change in one or both of the others.

$$\frac{P1\ V1}{T1} = \frac{P2\ V2}{T2}$$

E. Dalton's Law - Partial pressure Law

1. The total pressure exerted by a mixture of gases is the sum of the pressures that would be exerted by each of the gases if it alone were present and occupied the total volume.

Formula discussed during period on formulations.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

2. To illustrate, all cylinders are assumed to be of equal size.

   a. 60/20 N2 O2 mix = 80% N2 + 20% O2 = Orginal Pressure.

   b. At sea level (Atmosphere Absolute)

      PLACE ON CHALK BOARD

      0.8 ATM=11.76 psi (N2)

      0.2 ATM=2.94 psi (O2)

      1.0 ATM=14.70 psi Total pressure exerted.

   c. At 5 atmospheres absolute

      4.0 ATM=73.5 psi Total pressure exerted

   d. Total partial pressure exerted by O2 at 5ATM is approximately equal to the air pressure at sea level.

F. Henry's Law - Absortion Law

1. The amount of gas that will dissolve in a liquid at a given temperature is almost directly proportional to the partial pressure of that gas.

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2. Very important in the formulation of decompression tables. Three factors affect gas absorption by human tissues.

   a. Depth of dive

   b. Time of dive at depth.

   c. Condition of the body to supply and return N2 to and from the lungs.

EMPHASIZE

3. Gas di-fuses and dissolves in blood because of diff-erences in partial pressures between inhaled and exhaled air.

G. Archimedes' Principle - Laws of Floatation & Buoyancy

1. Any object wholly or partially immersed in a liquid is buoyed up by a force equal to the weight of the liquid displaced.

2. Deals with:

   a. Floatation

   b. Blow-ups

   c. Lifting capacities

   d. Buoyancy

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

3. The laws of Floatation:

   a. A floating body displaces a volume of liquid equal to its' own weight.

   b. A body sinks when the weight of the liquid displaced is less than the weight of the body.

   c. A submerged body remains in equilibrium when the weight of the liquid displaced equals the exact weight of the body.

   d. A submerged body will float when the body weighs less than the volume of the liquid displaced.

SHOW MOVIES MN8749 A&B
Med. Aspect of Diving
Mech. Effects of Pressure

6. Energy in Diving

   A. The effects of light rays underwater consists principally of four major changes in the divers' ability to perceive objectives.

      1. Intensity of light underwater is altered by:

         a. Light reduction due to absorption

         b. The brightness of the light.

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c. As the diver descends, the quantity of light decreases, but not necessarily in regular amounts because of density, salinity and turbidity changes.

2. Color Absorption

a. Increases with depth

b. Different colors are absorbed out of the visible spectrum as the diver descends.

(1) In clean water, red is removed first. Red objects appear black.

(2) Yellow is next, yellow objects appear blue.

(3) Green and finally blue are removed with progressively increasing depth.

3. Light Diffusion

a. Light rays are scattered and deflected in all directions.

b. Diffusion contributes to the reduction in total illumination,

but at the same time tends to aid vision by spreading the light evenly through the water at any given depth.

4. Light Refraction

a. Refraction causes bending and magnification of objects underwater.

b. Distances appear different underwater due to refraction.

(1) Objects appear one-quarter closer

(2) In turbid water, brightness dims, causing an apparent increase in the distance, which gets greater the farther away the object is.

B. Sound travels faster in water than in air.

1. The speed of sound in air is 1,090 feet per second.

2. In water, sound travels four times as fast.

3. Sound energy is greatly reduced when it passes from one medium to another.

a. Divers cannot talk to each other easily through water.

b. Tenders cannot shout to divers underwater.

4. Appreciable amounts of He02 or high pressure air can alter vocal quality to produce a "Donald Duck" effect in divers' speech.

APPLICATION

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SUMMARY:

I. Basic Concepts of Matter

a. Physics

b. Matter

c. Energy

d. Elements

e. Atom

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
f. Molecule		
g. Three States of Matter		
1. Solid		
2. Liquid		
3. Gas		
h. Factors affecting state of substances		
1. Temperature		
2. Pressure		
II. Units of Measurement		
A. Metric System		
1. Unit of length - meter		
2. Unit of length squared - area		
3. Unit of length cubed - volume		
4. Unit of weight - gram		
B. Fahrenheit and celsius temperature scales		
1. Conversion of scales		
a. Fahrenheit to celsius $c=5/9\ (F-32)$		

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b. Celsius to Fahrenheit
f=9/5Xc)+32

III. Pressure in Diving

A. Pressure

B. Force

C. Area

D. Types of Pressure

1. Atmospheric

2. Gage

3. Barometric

4. Absolute

IV. Composition of Air

A. Nitrogen

B. Oxygen

C. Argon

D. Carbon Dioxide

E. Rare Gases

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V. Gas Laws

A. Kenetic Theory

B. Boyles' Law

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

C. Charles' Law

D. General Gas Law

E. Daltons' Law

F. Henrys' Law

G. Archiemedes' Principle

VI. Energy in Diving

A. Underwater effects of Light

1. Intensity

2. Aborption

3. Diffusion

4. Refraction

B. Underwater Sound Effects

1. Speed of sound in air

2. Speed of sound in water

3. Sound reduction when passing from one media to another.

NAVAL SCHOOL DIVING AND SALVAGE

SCUBA Diver A-433-0023

Security Clearance : None

Lesson Topic: 2.2 Diving Formulas

6 Hours

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual, Vol. I

Student Guides

Standard Classroom Equipment

TERMINAL OBJECTIVE

1. When the student completes this course he will be able to, given a diving situation and a sheet containing formulas used in diving, select the applicable formula(s) and solve the problem posed in the situation.

ENABLING OBJECTIVES

1. Orally EXPLAIN the meaning of all symbols used in diving formulas

2. Orally EXPLAIN the application and use of all diving formulas.

3. DESCRIBE, in writing, the sequence of computation for determining:

   a. The area of a square/rectangle

   b. The area of a circle

   c. The volume of a cube

   d. The volume of a sphere

   e. The volume of a cylinder

   f. Lifting capacity in fresh water (in pounds)

   g. Lifting capacity in salt water (in pounds)

   h. Compressor out-put

   i. Over-bottom pressure requirement

   j. cut-off depth

   k. Maximum oxygen percent

   l. effective atmosphere

   m. partial pressure of a gas (in ps

ENABLING OBJECTIVES (CONT'D)

n. Volume left after falling (squeeze)

o. Volume increase after blow-up (embolism)

p. Emergency hose test

CRITERION TEST

1. Given a diving situation and sheet containing formulas used in diving, select the applicable formula(s) and solve the problem posed in the situation.

HOMEWORK

Volume A. Student Guide Assignment Sheets 2-2-1A thru 2-2-3A

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
PRESENTATION:		
A. Formula's for Area's	INST. Demonstrates all formula's	STUDENTS listen and ask questions
1. Area of a Square		
A=LxW		
A=Area		
L=Length		
W=Width		
2. Area of a Circle		
A=1/4 X D2 or A=π X R2		
1/4 = .7854		
D2= Diameter Squared		
A=Area		
π=3.1416		
R2=Radius Squared		
B. Formula's for Volumes		
1. Volume of A Cube		
V=LxWxH		
V=Volume		
L=Length		
W=Width		
H=Height		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. Volume of a Sphere V=1/6 X D3 (1/6 =.5236 V=Volume 1/6 = .5236 D3=Diameter Cubed	INST. Demonstrates	Students listen and ask questions.
3. Volume of a Cylinder V=1/4 X D2 X L V=Volume 1/4 =.7854 D2 = Diameter Squared L= Length		
4. Volume remaining after fall (squeeze) $\frac{DL + 33}{DA + 33}$ = Vol. Rem. DL=Depth left from DA=Depth Arrived at one/atmos +33=To make both depths absolute Vol. Rem. = Volume remaining		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
5. Volume Increase after Blow-up (air Embolism) $\frac{DL+33}{DA+33}$ = Vol. Inc. DL = Depth left from DA = Depth arrived at +33= one atmos. to make depth absolute Vol. Inc. = Volume increase		
C. Formula's for lifting capacities	INST. Demonstrates	Student listens and asks questions
1. L/C in F/W L/C = Vx62.4 - wt. of lifting unit (l/U) L/C = Lifting capacity V = Volume 62.4 - wt. of 1 cu ft F/W F/W = fresh water L/U = Lifting unit wt. = weight		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. L/C in S/W L/C V x 64 - wt. of lifting unit (L/U) L/C = lifting capacity V = Volume 64 = wt. of 1 c. ft. (S/W) S/W = salt water L/U = lifting unit wt. = weight	INST. Demonstrates	Student listens and asks questions

D. Formula's for Air Requirements

1. Compressor output (minimum)

$(\frac{D}{33} + 1) \times 4.5 \times N = CFM$

$(\frac{D}{33} + 1)$ = effective atmos. of the dive (absolute)

4.5 cu. ft. = min. vent requirements per man/min.

N = Number of divers

NOTE: Always calculate for at least two divers - one diving and one stand-by diver.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. Over bottom Requirement (D + 33) x .445 + 50 or 100 psi = OBR (D + 33) x .445 = psia at bottom +50 or 100 psi = required over. bottom pressure NOTE: It is desired to have 100 psi over bottom on dives deeper than 120 ft.	INST. Demonstrates	Student listens and ask questions

E. Formula's for HeO2 Diving

1. Cut off depth for O2

$$O2 = \frac{1.6 \times 33}{O2\%} - 33$$

(1.6 x 33 = 52.80 ft.)

O2 = Oxygen cut-off depth

1.6 x 33 = eff. atmos.

O2% = % of O2 for dive

-33 = psig in ans.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. Max. O2 $O2 = \frac{1.6 \times 33}{D + 33}$ O2 = Max. O2 percent for depth of dive 1.6 x 33 = eff. atmos. of dive D + 33 = absolute depth of dive	1.6 x 33 = 52.80 ft.	
3. Effective Atmospheres of Dive $E/F = \frac{(D + 33) \times O2\%}{33}$ E/F = Eff. Atmos. D + 33 = Absolute depth of dive O2 % = O2 percent used for dive 33 = number of ft. in 1 atmos.	(1.6 x 33 = 52.80 ft.)	

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TLINE OF INSTRUCTION	INSTR .TOR ACTIVITY	STUDENT ACTIVIT.

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F. Miscellaneous Formula's

1. Partial pressure of a gas

   P/P = (D + 33) x .445 x % of gas

   p/p = partial pressure

   (D + 33) = absolute depth of dive

   .445 = psi exerted by 1 ft. S/W

   % of gas = percent of gas in question

2. Emergency hose test

   (D + 33) x .445 + 50 or 100 x 2

   (Hold for :10)

   D + 33 = Absolute depth of dive

   .445 = psi exerted by 1 ft. S/W

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

50
100 psi = over-bottom req.

x2 = gives 100% over max. anticipated pressure of dive.

APPLICATION

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SUMMARY

I. Formula's for area

A. Square

B. Circle

II. Formula's for volume

A. Cube

B. Sphere

C. Cylinder

D. Vol. Remaining after fall (squeeze)

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

E. Vol. Increase after blow-up (air embolism)

III. Formula's for lifting capacities

A. L/C in fresh water

B. L/C in salt water

IV. Formula's for air requirements

A. Compressor output

B. over bottom requirement

V. Formula's for He02 diving

A. Cut-off depth for oxygen

B. Maximum oxygen per cent

C. Effective atmospheres of dive

VI. Miscellaneous Formula's

A. Partial pressure of a gas

B. Emergency hose test

NAVAL SCHOOL DIVING AND SALVAGE

SCUBA Diver A-433-0023

Security Clearance: None

Lesson Topic 3.1, Resuscitation

1 Hour

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual, Vol. I

Standard Classroom Equipment

Student Guides

"RESUSI-ANN" RECORDING DUMMY

AMBU Resuscitator

Plastic Airways

TERMINAL OBJECTIVE

1. When the student completes this course, he will be able to demonstrate proper procedures for the application of mouth-to-mouth and mechanical (AMBU) resuscitation.

ENABLING OBJECTIVES

1. Orally DESCRIBE emergency situations in which artificial respiration/resuscitation would be used.

2. Orally EXPLAIN the necessity for maintaining free unobstructed airway while administering artifical respiration/resuscitation.

3. Orally EXPLAIN the procedures for proper administration of artificial respiration/resuscitation.

4. Orally DESCRIBE the use of the mouth-to-mouth method of artificial respiration/resuscitation using a plastic airway.

CRITERION TEST:

Using a recording "Resusi-Ann", demonstrate proper procedures for the application of mouth-to-mouth and mechanical (AMBU) resuscitation.

HOMEWORK

Volume A, Student Guide, Information Sheet 3-1-1I; Assignment Sheets 3-1-1A and 3-1-2A.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
1. General considerations.	On C/B Abbreviations	
A. Definitions.	ECM - External cardiac massage.	
1. Cardiopulmonary arrest: the absence of functional ventilation and circulation in an individual not expected to die.	MSR - Mouth-to-mouth resuscitation.	
	CPR - Cardiopulmonary resuscitation.	
2. Resuscitation: Action taken to restore cardiopulmonary vital signs of breathing and heartbeat.		
B. Both cardiac arrest and lack of respiration may occur in the same victim.		
1. Where both conditions exist in the same pt. breathing must be restored first.		
a. If ventilation is not started in 4-6 min. cere-		

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bral anoxia, "Brain Death" that cannot be reversed begins.

b. Such ventilation must be swift and positive to be effective.

2. E.C.M. can be delayed until airway patency and ventilation have been restored.

2. Pulmonary Resuscitation.

A. Causes of pulmonary failure.

1. Mechanical blockage of airway.

a. Water-drowning

b. vomitus

c. blood

d. Foriegn bodies-false teeth, food particles, etc.

2. Paralysis of respiratory system.
   a. Damage to brain or spinal cord.
      1. Accidental trauma
      2. Chemical action, i.e. poisoning
   b. Electrical shock.
3. Disruption of respiratory muscle action due to trauma.
4. Reactions to medicine, food, etc. (anaphulactic shock).

B. Pulmonary resuscitation-Restoring Breathing.
1. Follow the "ABC's" of resuscitation.
   a. "A"-maintain airway patency.
   b. "B"-breathing - insure re-

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
spiratory exchange.		
c. "C"=cardiac output - check for pulse.		
2. Maintaining an open or patent airway.	Demonstrate on resusi-	
a. Open victims mouth.	ann (explain each step).	
1. Grab lower jaw & pull.		
2. Will tend to pull tongue from back of the throat.		
b. Extend head backward on the neck at the same time.	Demonstrate.	
c. Check for foriegn body- false teeth, food chunks, etc.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
1. May be vomitus-or food bolus(lump).	Demonstrate.	
2. Turn pt on one side and strike sharply between shoulder blades.		
3. Remove with forceps (tongs) or suction if necessary.		
3. Pinch victims nostrils.	Demonstrate.	
4. Apply mouth to victims mouth.	Demonstrate.	
a. Cover mouth & nose of small child.		
b. Make certain you have a seal.		
5. Exhale into PT's mouth.	B.S.	
a. Watch for chest rise.		
b. 800cc to 1000cc is the minimum amount required for adequate ventilation.		

6. Repeat 10-12 times per min. for an adult; 20 times per min. for child.
7. Continue MMR without interruption.
   a. If victim revives, watch for further need of respiratory assistance.
   b. Person initiating MMR can be relieved if it can be done without interuption.
   c. Continue until medical help arrives.

B. Mechanical resuscitation - "AMBU".

1. The AMBU bag/mask mechanical

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
resuscitator is preferable to M.M.R. a. More positive ventilation. b. Provides a better (mouth and nose) seal. c. Superior esthetic qualities. d. Can be utilized with O_2 bottle.	Show AMBU bag to T/E Pass around.	
2. Operated by manual compression of pliable rubber bag.	Demonstrate on Resusi-ann.	Student individually demonstrate ventilation by MMR.
3. Valuable tool for diving lockers. a. Should be on diving platforms/ boats. b. Keep one in or near chamber.	Correct mistakes as necessary.	
3. Cardiac resuscitation. That action or group of actions taken to restore heart output and cerebral circulation.		
A. Causes of Cardial arrest.		

1. Electric shock.
2. Traumatic shock.
3. Asphyxia
4. Combination of injuries or conditions.
   a. Hypoxia and shock.
   b. Shock and embolism.
   c. Trauma, shock and hemorrhage.
   d. Almost any traumatic combination, if severe enough.

B. Recognition of cardiac arrest.

1. Absence of a pulse in major vessel.
   a. Check carotid pulse at the side of the neck.
   b. Wrist pulse is most commonly used, but can be difficult to locate.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
c. Femeral pulse is reliable, but can be hard to find & inaccessible. (Women)		
2. Cyanosis, the condition of blue-tinged skin, lips & nail beds, indicates circulation failure.	Demonstrate how carotid pulse is taken. Use Resusi-anne.	
3. If heart action has been interrupted for more than 4 min. damage to brain (cerebral) will result.		
a. Revival after 4 min. will probably display some permanent damage.		
b. Extent of cerebral damage is directly related to length of time heart action has stopped.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
C. Cardiac resusitation, the restoration of cardiac sufficiency and circulatory flow.		
1. ECM - External cardiac massage.		
a. Can arfiticially maintain upto 30% of blood flow to brain & vital organs.		
b. Massage should be continued until revival, stopped by medical officer or doctor, or until carotid pulse has been absent for 15 min.		
2. Method of application.	Demonstrate ECM using Resusi-anne.	
a. Check for carotid pulse.		
b. If cardiac arrest was witnessed, one initial sharp blow to the sternal area		

may restore heart action.

c. Place victim on a rigid surface.

d. Kneel on either side of victim.

e. Place heel of either hand on lower half of sternum, with fingers pointing towards opposite armpit.

f. Place other hand over the first to give added force in overcoming rib cage resistance.

g. Get shoulders up over wrists and lock your elbows.

h. Exert force downwards, using body weight to depress the rib cage about 1 1/2 inches.

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1. Release pressure.

2. Repeat the compression-release cycle.

3. Frequency should be about one cycle per second.

D. When both respiratory and cardiac arrest exist in the same victim:

1. Provide 3 quick ventilations.

2. Deliver one quick blow to the chest.

3. Begin ECM.

4. Alternate ECM and MMR on a ratio of eight compressions to one ventilation.

5. Recheck for carotid pulse every 1 min.

6. Maintain this rhythm until revival, victim is pronounced dead, or no

pulse is detected for
15 min.

7. Send for medical assistance.

E. Other advanced cardio pulmonary resusitation techniques.

1. Electrical defibrillation

a. Most successful when applied within 30 seconds of collapse.

b. A DC capacitor discharge apparatus is used:

1. Paddles applied to chest wall.

2. 400 watt-seconds jolt is used.

3. 60-100 w-s for children.

c. Alternate defibrillation with ECG.

2. Drug therapy can be utilized in conjunction with E.C.M.

   a. I.V. administration of fluids and drugs.

   b. Intra cardiac injection can be used.

   c. Some drugs administered are:

      1. Epinephizine.

      2. Isoproterenol.

      3. Calcium chloride.

      4. Sodium bicarbonate.

      5. Norepinepitrine(levo phed).

      6. Metaraminol(aramine).

      7. Atropine.

NAVAL SCHOOL DIVING AND SALVAGE

SCUBA Diver A-433-0021

Security Clearance: None

Lesson Topic 3.2, Hemmorrhage Treatment

1/2 Hour

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual, Vol. I

Student Guides

"RESUSI-ANN" RECORDING DUMMY

Standard Classroom Equipment

Bandage Material

Tourniquets

TERMINAL OBJECTIVE

1. When the student completes this course, he will be able to demonstrate the treatment of hemorrhage through the utilization of pressure point and/or direct pressure methods.

ENABLING OBJECTIVES

1. SHOW, by pointing, the major pressure points of body.

2. Orally EXPLAIN the conditions that warrant the use of a tourniquet.

3. Orally STATE the danger of loosening a tourniquet.

4. Orally EXPLAIN the pressure point method of treatment for a hemorrhage stressing areas of the body where the method is applicable.

5. Orally EXPLAIN the direct pressure method of treatment of hemorrhage stressing areas of the body where the method is applicable.

CRITERION TEST

1. Using the "Resusi-Anne" Recording Dummy as a victim with the instructor indicating hypothetical wounds, demonstrate the treatment of hemorrhage through the utilization of pressure point and/or direct pressure

HOMEWORK

Volume A, Student Guide Assignment Sheets 3-2-1A and 3-2-2A.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
1. Control of Massive Hemorrhage.	List on C.B.	Take notes as necessa
A. Types of Hemorrhage.		
1. Arterial Bleeding.		
a. Bright red blood color.		
b. Jets or spurts of blood coinciding with heart beat or pulse.		
2. Venous Bleeding.		
a. Dark crimson color.		
b. Steady Stream of blood.		
B. Location of Hemorrhage.		
1. External bleeding is easily seen.		
2. Internal bleeding is difficult to diagnose and more difficult ot manage. Signs of this event include:		
a. Moist Clammy pale skin.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

b. Weak, rapid pulse.

c. Depressed blood pressure.

d. Possible fainting.

e. Presence of blood in vomitus urine stool, or in coughed-up mucous.

3. Control of internal bleeding is best left to trained medical personnel.

C. Control of external arterial & Venous Hemorrhage.

1. Direct Pressure. — Demonstrate using "Resusi-Ann". — Observe

a. Method of choice.

b. Apply pressure directly over the injury and apply firmly.

c. Use sterile bandage material if it is available.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
d. Anything can be used in emergency.		
2. Pressure points.		Each student demonstrate procedure using "Resusi-Ann".
a. Method of dubious value.		
b. Points are easily forgotton.		
c. May be difficult to locate.		
d. Effectiveness increases when used in conjunction with direct pressure.		
3. Tourniquet application.	Demonstrate using "Resusi-Ann".	Observe.
a. Applied above site of injury.		
b. Closes entire blood supply below site of application.		
c. Amputation often results as a consequence of its use.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
d. Reserve tourniquet applications to situations where later amputation is a likely possibility.		

NAVAL SCHOOL DIVING AND SALVAGE

SCUBA Diver A-411-0023

Security Clearance: None

Lesson Topic 3.3, Shock Treatment

1 Hour

INSTRUCTIONAL MATERIAL:

U.S. Navy Diving Manual, Vol. I

Standard Classroom Equipment

"RESUSI-ANN" RECORDING DUMMY

Student Guides

TERMINAL OBJECTIVE

1. When the student completes this course he will be able to demonstrate the first aid treatment for victims of shock.

ENABLING OBJECTIVES

1. Orally STATE the most common cause of shock.

2. Orally DESCRIBE the symptoms of shock.

3. Orally EXPLAIN the procedures for treatment of victims of shock.

CRITERION TEST

Using the "RESUSI-ANN" Recording Dummy as a hypothetical victim, demonstrate the first aid treatment for victims of shock.

HOMEWORK

Volume A, Student Guide Assignment Sheet 3-3-1A.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Shock Syndrome		
A. Shock is defined as the rapid depression of circulatory body centers.		
1. Fluid loss to tissues due to increased permeability of vessel walls.		
2. Resultant loss of O_2, heat and some CO_2 retention.		
B. Types of shock.	List on C.B.	Take notes as necessary.
1. Oligemic shock - loss of blood.		
2. Emotional shock.		
3. Traumatic shock - result of any injury.		
4. Electrical shock.		
5. Toxic shock - Action of some poisons.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
C. Symptoms 1. Eyes are glassy and dilated. 2. Breathing is rapid, becoming shallow and irregular in advanced shock. 3. Skin and lips may be pale or greyish-blue. 4. Restlessness and aprehension.	List on C.B.	Take notes as necessary.
D. Treatment. 1. Lay patient down and elevate feet. 2. Keep warm to conserve heat. 3. If conscious, give him small sips of soda bicarbonate by mouth. 4. Reassure him & prevent from viewing his injuries.	Demonstrate using "RESUSI-ANNE"	Individually demonstrate procedures.

NAVAL SCHOOL DIVING AND SALVAGE

SCUBA DIVER A-433-0023

SECURITY CLEARANCE: NONE
LESSON TOPIC 3.4, First Aid Treatment

5 1/2 Hours

INSTRUCTIONAL MATERIALS:

U.S.Navy Diving Manual, VOL. I
Standard classroom equipment
Student guides
Bandages and splinting material
Stokes, Ridgid, and Semi-ridgid litters
Reference: Handbook of the Hospital Corps

TERMINAL OBJECTIVE.

1. When the student completes this course, he will be able to, given a hypothetical case requiring first aid treatment, describe, in a sequence of steps, appropriate action. Include, as a minimum, name of injury/condition, treatment and post-treatment actions.

ENABLING OBJECTIVES

1. Orally STATE the three purposes of first aid.
2. Orally DESCRIBE the conditions that necessitate the rescue of an injured person prior to the administration of first aid.

ENABLING OBJECTIVES (CONT'D)

3. Orally STATE the general first aid rule.
4. DEFINE, in writing, terms used in first aid
5. Wounds:
   a. Orally STATE the three basic rules in treating wounds.
   b. Orally DESCRIBE the principles involved in dressing wounds of the head, neck, chest, abdomen and limbs.
6. Fractures:
   a. EXPLAIN, in writing, how to immobolize the following types of fractures:
      (1) Simple
      (2) Compound
      (3) Greenstick
      (4) Comminuted
      (5) Impacted

ENABLING OBJECTIVES (CONT'D)

b. DESCRIBE, in writing, the immobilization and transportation of a person with a fractured spine.

7. Heat victims:

a. Orally DESCRIBE the treatment for heat exhaustion.

b. Orally DESCRIBE the treatment for a victim suffering a heat stroke.

8. Burns:

a. DESCRIBE, in writing, the three degrees of burns and how they are determined.

b. DESCRIBE, in writing, the immediate first aid treatment for burn victims.

9. Cold injuries:

a. Orally DESCRIBE the categories of cold injuries.

b. DESCRIBE, in writing, the treatment for various degrees of cold injuries.

10. Personnel rescue:

a. Orally DESCRIBE each of the following stretchers and their uses:

(1) Neil-Robertson

(2) Stokes

(3) Army litter

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ENABLING OBJECTIVES (CONT'D)

b. Orally DESCRIBE the procedures to be followed to remove a victim of electrical shock in terms of your own safety.

c. Orally DESCRIBE the procedures to be followed to remove a victim overcome by toxic fumes in terms of your own safety.

11. DESCRIBE, in writing, the procedure for treatment of snake bite.

12. Animal bites:

a. Orally DESCRIBE the major concern in all animal bites.

b. DESCRIBE, in writing, the treatment for animal bites.

CRITERION TEST

1. Given two hypothetical cases requiring first aid treatment, describe, in a sequence of steps, the appropriate action. Include, as a minimum, name of injury/condition, treatment and post treatment actions.

HOMEWORK: Applicable Workbook (Student Guide) Assignment.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. General Principles		
A. Purposes of first aid.	Place purposes on C/B	Take notes/complete fill-ins.
1. To save life.		
2. The prevention of further injury.		
3. Preservation of vitality in an accident victim.		
B. General rules for administration of First aid.	Emphasize by example	
1. Keep the patient in the prone position unless injury indicates otherwise.		
2. Determine the extent of victims injuries.		
a. Cardfully remove clothing from around the wound.		
b. Visually check for further obvious injuries & priority conditions.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

c. Examine extremities for broken bones.

3. Do NOT attempt to move or transport the victim until you have fully examined him.

4. Do NOT give an unconscious victim anything by mouth.
   a. May block airway.
   b. May induce choking or vomiting.

5. Try to prevent the victim from seeing his injury.
   a. May induce or deepen shock.
   b. May make further examination difficult.

6. Reassure the victim.
   a. Allay his fears.
   b. Provide a calming influence.

7. Act calmly, quickly and efficiently.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
C. Definitions used in First Aid.		
1. First aid is that action taken to preserve life and vitality and insure safe removal to medical assistance.		
2. A wound is a break in the continuity of the skin that results in an opening in the skin.		
3. A fracture is a broken bone that is a result of a trauma.		
4. Trauma is any injury to the body and can be mental as well as physical.		
D. Emergency First Aid Priorities.		
1. First priority must be accorded to respiratory failure.	EMPHASIZE.	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

2. Cardiac resusitation to restore blood flow to vital organs if the heart has stopped.
3. Massive arterial and/or venous hemorrhage must be checked effectively or serious and possibly fatal blood loss can occur.
4. Treat for shock.
   a. Some degree of shock is present in all trauma cases, and should be dealt with, even if no symptoms are displayed.
   b. Fatalities from shock have occured as a result of seemingly inconsequential injuries.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

5. Treat for burns, if necessary.

6. Check for and manage any broken bones.

II. Wounds and Their Management. Place rules on C/B

A. Three basic rules of wound management.

1. Stop bleeding.

2. Reassure skin continuity - close it up.

a. Use sutures.

(1) If qualified; or

(2) If further medical attention impossible.

b. Butterfly.

c. Wound dressing.

3. Prevent infection.

a. Avoid contaminating the wound

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
b. Clean before closing. c. Use sterile or clean dressing material.		
B. Types of Wounds: 1. Incision - made by sharp object. The wound has smooth edges. 2. Laceration - torn skin and tissue with ragged and uneven edges. 3. Contusion - Bruise, underlying tissue may be torn and bleeding with surface unbroken. 4. Abrasion - caused by scraping the skin surface. 5. Puncture - usually small and deep, caused by nails, stab wounds, bullets & snake bite.	List on C/B or use transparency.	Take notes as necessary.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
6. Crush wound usually involves extensive damage to internal structures, and the skin is not normally broken, but if it is, it is not the primary consideration.		
III. Fractures - Broken Bones.		
A. Fractures are classified as follows:	List on C/B or use transparency.	Take notes as necessary.
1. Closed or simple - Bone broken but skin is unbroken.		
2. Open or compound - Bone broken with part of the bone exposed.		
3. Greenstick - bent, cracked but not broken all the way through; common in children.		
4. Comminuted - crushed, splintered or broken into several or many fragments.		

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OUTLINE OF INSRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

5. Impacted - One fragment of bone forcibly driven into the other and remaining fixed.

B. General Management of Fractures.

1. Check for arterial or venous bleeding that may be caused by the fragments.

2. Immobilize the break.

a. Splint.

b. Avoid movement of injury until splint is applied.

c. It is often best to "splint them as the lay" if medical help is close.

3. Treat for shock.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
IV. Burn Management.		
A. Classification of burns is made according to extent of burned surface and the depth of the lesion.	Place on C/B:	Copy diagram
1. Total amount of surface involved is calculated roughly by the rule of nines.		
2. 15% involvement induces shock (10% in children.) 20% involvement endangers life. 30% total body area is usually fatal.		
3. Depth of lesion is referred to in degrees:		
a. 1st degree burn involves only the outer layer of skin with redness and mild pain.		

b. 2nd degree involves deeper skin layers with blistering and more severe pain.

c. 3rd degree burns destroy all skin layers and can involve deeper tissue. Pain may be absent (nerves destroyed) and healing is lengthy.

B. First Aid for Burns.

1. Relieve pain if the means is available.

2. Treat for shock.

3. Prevent infection.

a. Remove soiled clothing carefully.

b. Avoid ointments and lotions.

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

4. Ice water baths for areas of involvement that amount to less than 20%.
   a. Use to alleviate pain.
   b. Continue until pain is gone 30 min. to 5 hrs. if necessary.

V. Heat Casualties.

A. Hot enviornments require increased circulation to the skin to cool the body. Failure to meet this demand and the demands made at the same time to perform work can produce collapse.

1. Heat stroke.

2 Heat exhaustion.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
B. Heat stroke is an emergency calling for immediate attention. 1. Symptoms include: a. Cessation of sweating, high fever. b. Weakness, headache, dizziness. c. Mental confusion, staggering gait. d. Delerium. e. Coma. f. Confulsions. g. Deep shock. h. Circulatory collapse. i. Death. 2. Temperature rise can be fantastic - 105-106 and as high as 108. Above this damage to the brain occurs.	List on C/B or use transparency	Take notes as necessary

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
3. Treatment is aimed at reducing temperature rapidly.		
a. Total immersion in ice water.		
b. Cool with fine mist or spray.		
c. Massage the extremities during cooling.		
d. Wrap in cool; wet sheet or blanket.		
e. Get to medical attention.		
C. Heat Exhaustion is not as severe, nor does it carry the grave prognosis of heat stroke.		
1. Symptoms.		
a. Faintness & palpitation predominate.	List on C/B or use transparency	Take notes as necessary
b. Profuse sweating.		
c. Nausea, vomiting, headache.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

d. Unconsciousness.

2. First aid.

a. Remove to cool environment.

b. Give cool salt water (0.1%).

c. Take salt tablets as a preventative measure.

VI. Cold casualties.

A. Cold injuries generally result from the slowed or impeded blood flow, and the severity of the injury is directly related to the intensity duration of exposure, and other complicating factors such as wind, wetness, and trauma.

B. Basically, there are two types of cold injury, freezing and non-freezing, but it is rare when

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
all of one condition exists without some degree of the other present.		
C. Cold injuries are classified by degree.	List on C/B or use transparency	Take notes as necessary
1. First degree - Chilblains.		
a. Symptoms.		
(1) Redness & Swelling.		
(2) Itching, Burning dermatitis.		
(3) Tingling & possibly a deep ache.		
b. Treatment.		
(1) Little is required aside from removing and rewarming victim.		
(2) Examine for more serious cold injury.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

2. Second degree - Immersion foot and trenchfoot.

   a. Immersionfoot occure from exposure to water 50° or less for 12 hrs or more.

   b. Trenchfoot results from exposure to cold environment (not necessarily water) for from 3-14 days.

   c. Symptoms are similar for both:

      (1) Affected part blanches, tingles & gets numb.

      (2) Swelling & cyanosis.

      (3) Blisters (blebs)

      (4) Intense burning pain

      (5) Neuro-muscular changes

d. Treatment is the same for both.

(1) Where tissue is not macerated, a dressing is not required.

(2) During transport, or if there is possibility of tissue loss, bandage loosely.

(3) Do not rupture blisters.

(4) Seek medical assistance.

3. Third Degree - Frost bite.

a. Occurs after brief exposure to extreme cold. (-20° F and below).

b. Symptoms.

(1) Burning, stinging, and numbness.

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(2) Grey or white waxy color to affected part due to ice crystals in the skin, especially over bony prominences.

(3) Edema.

(4) Deep aching pain.

(5) Limitation of motion.

(6) Possible subsequent gangrene and tissue loss.

c. Treatment.

(1) Rapid thawing in water 107° to 109° F.

(2) Ally pain.

(3) Prevent trauma to injured part.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVIT

4. Fourth Degree - Freezing.
   a. Occurs after exposure to temperatures below -20°F.
   b. Symptoms.
      (1) Pallid yellow waxy color caused by ice crystals in tissues of affected part.
      (2) Skin will not move over bony prominences.
      (3) Edema and deep pain.
      (4) Loss of motion.
      (5) Gangrene & tissue loss.
   c. Treatment for freezing is the same as for frost bite.
5. Avoid thawing a freezing casualty if the part will be re-exposed to cold. Thawing and refreezing an extremity seals its fate.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
VII. Transportation and Personnel Rescue.		
A. Transporting an injured person generally involves use of a stretcher or litter.	Show strecther to class	
1. Neil-Robertson.		
a. A semi-rigid litter.		
b. In use, it wraps around the patient like a mummy.		
c. Main use is in transporting a victim out of a small space or through a narrow opening.		
2. Stokes Stretcher	Show stretcher to class	
a. A rigid, basket type litter.		
b. Best and easiest method of moving a victim.		

(1) Safest for injured man.

(2) Easy to carry.

c. Difficult to get through the hatch or a recompression chamber

3. Army Litter. Show litter to class

a. Rigid, collapsable litter.

b. Best for field use due to its portability.

B. Personnel rescue in hazardous enviornments.

1. Electric shock victim.

a. Remove casualty by loose clothing, if possible.

b. Secure power if possible.

c. Insure that you do not come in direct contact with the victim until power source is removed or disconnected.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. Toxic gas or smoke casualties.		
a. Do not enter a suspect space until it has been de-gassed or rendered safe.		
b. If you must, use proper protective equipment such as an O.B.A.		
VIII. Poison wounds and animal bites	List on C/R or use transparency.	Take notes as necessary
A. Snake bites.		
1. Try to learn type of snake involved.		
2. Use appropriate antivenom if available.		
3. Immobilize affected part.		
4. Apply a tourniquet above the bite that will block venous flow.		
5. Treat for shock		
6. Get to medical assistance.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

B. Animal bites.

1. With mammal bites, the chief concern is rabies.
   a. Any unproven mammalian bite requires careful handling.
   b. Capture the animal alive if possible.
   c. Observe animal 8-10 days.
   d. Established, symptomatic rabies is 100% fatal. If animal cannot be located, rabies vaccination must be instituted.
2. Non-rabid animal bites can be treated as wounds.
   a. Cleanse wound.
   b. Bandage.
   c. Seek medical attention.

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NAVAL SCHOOL DIVING AND SALVAGE

SCUBA Diver A-433-0021

Security Clearance: None

Session Topic 3.5, Diving Disease/Injury Treatment Part 1

2 Hours

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual

Standard Classroom Equipment

Student Guides

Overhead Projector

Transparencies

TERMINAL OBJECTIVES

Partial attainment of the following:

1. When the student completes this course he will be able to demonstrate proper procedures for the application of mouth-to-mouth and mechanical (AMBU) resuscitation.

2. When the student completes this course he will be able to demonstrate the treatment of hemorrhage through the utilization of pressure point and/or direct pressure methods.

3. When the student completes this course he will be able to, given a hypothetical case requiring first aid treatment, describe, in a sequence of steps, appropriate action. Include, as a minimum, name of injury/condition, treatment and post treatment actions.

4. When the student completes this course, he will be able to, given a hypothetical case involving a disease/injury/conditions common to diving, describe, in a sequence of steps, appropriate action. Include, as a minimum, name of disease/injury/conditions, selections of proper treatment table, if appropriate, treatment and post treatment actions. If treatment tables are necessary, make correct log entries.

ENABLING OBJECTIVES

1. Circulatory and Respiratory System:

   a. List, in writing, the major organs in each system.

ENABLING OBJECTIVES (CONT'D)

b. Given an illustration of the systems, TRACE a drop of blood and a molecule of air through the applicable system.

c. Orally DESCRIBE the interface of the two systems and their importance to diving.

d. DESCRIBE, in writing, the manner in which selected conditions hinder normal operation of the systems.

CRITERION TESTS

None

HOMEWORK

Volume A, Student Guide Assignment Sheets
3-5-1A through 3-5-7A.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
INTRODUCTION TO LESSON		
1. Establish contact.	1. Introduce self & topic. a. State C/B policies.	
2. Establish readiness.	2. Get students ready to learn. a. Pass out handouts. b. Insure students have Div Man.	
3. Establish effect.	3. Value of anatomy & physiology of Resp. & Circ. systems to the student. a. Aid in understanding body mechanics. b. Understand how O_2, N_2, CO_2 affect the body. c. Such knowledge can prepare the T/E for his role as a diver.	

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
	d. Facilitate understanding of the treatment Process.	
4. Overview of lesson.	4. State the T.O. and enabling objective.	
1. Circulatory system.		
A. Anatomy - Consists of 3 basic items.		
1. Heart.		
a. Situated behind breast bone (sternum)	Place drawing C/B.	Copy in Class notes.
b. Consists of two pumps.		
1. Pump on right side takes blood from the venous system and pumps it out into & through the lungs, then the pulmonary circuit returns to		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

the left side of the heart.

2. Pump on the left side propels the blood from the lungs out into the body. (This is known as the systemic circuit).

c. Efficiency of the heart is well known - works continually all of our lives without stopping.

2. Blood vessels - the "piping" system that carries the blood to the various tissues & organs throughout the body.

Place diagram of circ. system on C/B.

a. Arteries carry blood away from the heart into systemic

circulation.

1. Largest artery in the aorta.
2. Arteries diminish in size as they get further from the heart and they increase in number.
3. Small arteries are known as arterioles.
4. Arterioles branch out into the capillaries.

b. Capillaries are the smallest and most numerous of the blood vessels.

1. All body cells are close to at least one capillary.

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2. Can be as small as the diameter of one red blood call.

c. Veins are blood vessels that serve to return blood to the right side of the heart.

1. Smallest veins are called venules.

2. Venules increase in size and diminish in number.

3. Finally attaining sufficient size and known as veins.

4. Largest vein is the venacava that flows directly into the Right side of the heart.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
5. Some of the larger veins have "check valves" to prevent backflow.		
3. Blood. A fluid tissue that has 4 main components.	List on C/B	Copy in notes.
a. 50% of the blood is liquid.	a. RBC	
b. 50% are solids (cells & platelets).	b. WBC	
c. About 5 quarts in the average body.	c. Plasma	
	d. Platelets	
4. a. Red blood cells (RBC's) comprise about 45% of total blood volume.		
1. Carry most of the oxygen to cells and tissues.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

2. Transport CO_2 from cells and tissues to the lungs.

1. Hemoglobin on the RBC molecule binds with O_2 and releases it to the cells where it is utilized in the oxidation of food to produce energy and heat by the cell.

a. O_2 rich hemoglobin is bright red in color - arterial.

b. O_2 poor hemoglobin is a dull bluish red - venous.

b. White blood cells (WBC's)

1. Fight disease.
2. Body can rapidly produce WBC's to fight off infectious agents.
3. Normal RBC/WBC ratio is 700/1.

c. Plasma.
1. Liquid portion of the blood.
2. Cools the tissues.
3. Vehicle for RBC/WBC.
4. Carries other nutrients to the cells.

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d. Platelets - involved in the clotting process in the blood.

E. Physiology of the circulatory system.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
1. Venous blood returns from systemic circulation to the right side of the heart. a. Oxygen poor. b. CO_2 rich. 2. This blood is pumped into the capillary bed in the lungs. a. O_2 taken up by the RBC's. b. CO_2 given up by the RBC's. 3. O_2 rich blood is pumped back into the left side of the heart. 4. From here it is pumped into the systemic cir-	Trace blood through the circ. system on C/B.	T/F follow using diagram on figure 3-8, page 3-7 DuVan.

culation via the arterial network.

5. Through the arteries to the capillaries.
6. Here the RBC gives off its O_2 to cells and picks up the CO_2 produced by cellular metabolism.
7. The blood then is transported to the venous system and eventually back to the heart.

Anatomy of the respiratory system.

1. Respiratory system is divided in three parts.
   a. Passageways leading to the lungs.
   b. The lungs.
   c. Accessory organs

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. Passageways leading to the lungs. a. Oral-nasal cavity consists of the mouth, nose and sinuses that serve to funnel air down to the lungs, cleaning and either warming or colling it. b. The trachea is a cartilliginous tube that contains the larnyx and directs air into the bronchi. c. The bronchi begins at the bottom of the trachea, and branch out into smaller and more numerous bronchi. d. The bronchi continue to divide and become reduced in size un-	Diagram of C/B	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

til they become bronchioles, which feed air into the alveoli.

3. The lungs.
   a. Divided into lobes containing alveoli.
      1. Left lung has 2 lobes.
      2. Right lung has 3 lobes.
   b. The alveolus is a tiny air sac at the end of the bronchiole.
      1. About 300 million in the lungs.
      2. Present a large surface area to inhaled air.
      3. Site of gas absorbtion and exchange.

Diagram on C/B

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
4. Accessory organs & structures.		
D. Respiratory Physiology-consists of breathing mechanics and gas exchange in the lungs.		
1. Mechanics of breathing.		
a. Diaphragm, the major breathing muscle moves down and the rib cage moves up and outwards, creating a negative pressure in the lungs.		
b. Air rushes into equalize the pressure, filling the lungs.		
c. The diaphragm relaxes, moves up and the rib cage falls, creating positive pressure, and air rushes out.		
2. Gas exchange.	Diagram on C/B.	

a. As air enters the lungs it comes in contact with the alveolar surface.

b. O_2 is quickly absorbed by the alveolar lining and diffuses into the capillary bed that is on the other side of the alveolar surface.

c. The higher partial pressure of the O_2 in the alveoli serves to push O_2 into solution on the red blood cells which have a lower partial pressure of O_2.

d. At the same time, the RBC has a higher partial pressure of CO_2, the product of cellular metabolism, and this CO_2 is driven from the blood into

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

the lungs where a lower pressure of CO_2 exists.

e. This gas exchange occurs very rapidly so that the partial pressures of the dissolved gases in the blood that leaves the lungs is almost the same as the pressures in alveolar air at exhalation.

1. This gas exchange in the lungs is known as external respiration.

4. As the oxygenated blood reenters arterial circulation, it continues to travel, oxygenating various tissues and cells.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
a. Cells have metabolized and produced CO_2, using oxygen in the process. b. Oxygenated blood then approaches the cell and a similar gas diffusion takes place, driven by the high O_2 tension in the RBC, and the high CO_2 tension within the cell. c. This gas exchange at the cellular level is known as internal respiration.	Diagram on C/B.	

NAVAL SCHOOL DIVING AND SALVAGE

SCUBA Diver A-433-0023

Security Classfication: None

Lesson Topic 3.5, Diving Disease/Injury Treatment Part II

8 Hours

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual

Standard Classroom Equipment

Student Guides

Overhead Projector

Transparencies

Reference: Physiology and Medicine of Diving, Fennett & Elliott

TERMINAL OBJECTIVES

1. When the student completes this course he will be able to, given a hypothetical case involving a disease/injury/condition common to diving, describe, in a sequence of steps, appropriate actions. Include, as a minimum, name of disease/injury/condition, selection of proper treatment table, if appropriate, treatment and post treatment actions. If treatment tables are necessary, make correct log entries.

ENABLING OBJECTIVES

1. DESCRIBE, in writing, the symptons, causes, and proper methods of prevention/treatment for selected diver's diseases and injuries.

CRITERION TESTS

None

HOMEWORK

Volume A, Student Guides
Day 1 - Assignment Sheets 3-5-8A through 3-5-12A
Day 2 - Assignment Sheets 3-5-13A through 3-5-16A

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
INTRODUCTION TO THE LESSON		
1. Establish contact.	Introduce self & topic.	
2. Establish readiness.	1. State C/R Policies. 2. Get T/E's ready to learn. a. Pass out handouts.	
3. Establish effect.	3. Value of Topic to T/E. a. Knowledge may save life. b. Understanding of topic prevent accidents. c. Aid the T/E in his role as a diver. d. Recognize possible cases for recompression treatment.	
4. Overview of lesson	4. State T.O. and the enabling objective.	

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
Divers Diseases and Injuries		
1. In-water medical emergencies.		
A. Gas embolism-most serious diving emergency.		
1. Caused by air that has been trapped during ascent.	Diagram on C/B Baloon expanding under pressure; as pressure is decreased volume is increased.	
a. With sufficient expansion (volume increase) the gas will rupture the alveolar membrane.		
b. Gas bubbles escape into the capillary bed that surrounds the alveoli.	Diagram on C/B.	
c. This blood/bubble mixture must go directly to the left side of the heart, and from this point, the bubbles may rapidly travel to the brain	Refer to circulatory pathway	

producing rapid symptoms.

2. Symptoms of gas embolism are most commonly very quick in appearance, and dramatic in nature.

   a. The victim may become unconcious without any warning or other symptoms. This may occur even while the diver is still in the water or shortly (within 5 min.) after reaching the surface.

   b. Other signs and symptoms that will occur quickly include:

      1. Dizziness.

      2. Paralysis or weakness in the extremities.

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1. Blurring of vision.
4. Convulsions, bloody, frothy sputum.
5. Diver may have felt a "blow to the chest" during ascent, signifying lung-rupture.

c. These symptoms are the same as may be seen in a stroke victim. It must be remembered that they occur very quickly in the stricken diver.

d. The result of the air bubbles in the brain arteries is death of brain cells as they become O_2 starved. Since this tissue will not

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
regenrate, rapid treatment measures must be instituted to off set the possibilities of permanent damage or a fatality.		
3. Any diver, who has had a source of gas at depth, that surfaces unconsious or becomes unconsious within :05 after arriving on the surface must be assumed to have a gas embolism, regardless of any factor that may explain the condition.	Stress this point heavily. Elaborate.	
4. Treatment of gas embolism.		
a. Recognition of symptoms.		

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b. Immediate recompression on one of the standard treatment tables.

1. Compress to 165' to resolve the bubbles causing symptoms.

2. Utilization of O_2 (if available) to facilitate the outward partial pressure gradient of the offending gas.

c. Hospitalization may be required for ancillary treatment.

5. Prevention of gas embolism.

a. Medical screening to eliminate personnel with history or evidence of lung disease.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

b. Proper training of diving personnel:

1. Alertness to dangers.

2. Proper utilization of equipment.

c. Evaluation of diver's physical condition prior to diving for:

1. Temporary respiratory problems as colds, bronchitis.

2. Overall physical condition.

B. Drowning (or near-drowning).

1. Fatal hypoxia brought on by:

a. Panic or over-exertion in a swimmer.

b. Accidental loss of breathing equipment.

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c. Any combination of these factors may result in drwoing.

2. Drowning in deep sea rig is rare, only 2 cases are known due to loss of helmet.
   a. Even with torn suit, the MK V diver is as safe as long as he remains upright.
   b. Upside down diver with torn suit, spit cock open or depressed chin button is in trouble.

3. Drowning in SCUBA or light-weight gear is more common.
   a. Gear is more easily lost.
   b. Greater opportunity for panic.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

c. Ditching gear on the bottom can result in drowning.

d. Tenders could pull lightweight mask from divers face.

4. Treatment of drowning.

a. Restoration of respiration.

1. Mouth-to-mouth resuscitation.

2. Artificial resuscitation.

b. Restoration of heart beat by closed-chest cardiac massage.

c. Placing the revived victim under hospital care.

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1. Near-drowning victims may display delayed pulmonary edema.
2. Hospitalization of near-drowning mandatory regardless of the severity of the accident.

5. Prevention of drowning rests principally in observation of safety precautions.
   a. Physically fit swimmers and divers rarely fall victim to drowning.
   b. Training in proper utilization of diving equipment and the safety measures to be followed with each piece of gear should be emphasized.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
C. Barotrauma (Squeeze)		
1. Caused by an imbalance of pressures between various hollow spaces and organs within the body and the surrounding atmosphere or pressure.		
2. Generally, the only types of squeezes that present a possible life-threatening situation are lung (thoracic) squeeze and body squeeze.		
a. Body squeeze results with the deep-sea dress when the air pressure to the diver inside the dress fails to balance the exterior water pressure.	Illustrate on C/B.	

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1. Compressor failure or cut air hose & no non-return.
2. Rapid fall of the diver and his inability to compensate for the increasing exterior water pressure.
   a. Tends to squeeze diver into helmet & breastplate.
   b. Can possibly be fatal.
3. Such a fall can occur following a blow-up with rupture of the dress, if the tenders fail to take in the diver's slack as he ascends.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
from pulmonary edema and pneumonia.		
3. Prevention of barotrauma.		
a. Controlled descent.		
1. Do not exceed 75 FPM.		
2. Stop descent if pain occurs.		
3. Abort dive if pain fails to clear.		
b. Proper diver indoctrination and training.		
4. Ear squeeze. Two types of ear squeeze can result from an imbalance of pressure.	Illustration, overlay, transparancy or C.B. drawing of ear canal.	Copy in notes or label drawing in handouts.
a. A middle-ear squeeze is a result of a blocked eustachian tube.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
1. Air space formed between ear drum (tympanic membrane) and the site of closure in the eustachian tube.		
2. Fluid, mucous, and blood fill the space behind the drum to equalize pressure.		
3. If descent is not stopped or the blockage not cleared, a ruptured ear drum could result.		
4. Symptons are pain that increase upon pressure increase.		

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a. Ruptured drum could allow in rush of cold water which can cause vertigo with momentary nausea.

b. Pain usually stops when drum ruptures.

5. Prevention of middle-ear squeeze.

a. Insure ability to clear (valsalva maneuver) prior to diving.

b. Use decongestants and/or antihistamines

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
to dry mucous membranes prior to diving.		
c. Use controlled descent (sec. I. A.1.a.)		
d. Abort dive if necessary.		
b. External ear squeeze is a result of blockage of the external auditory canal.	Diagram as with I.C.4.	
1. Tight fitting hood or ear plugs cause an air pocket in the external auditory canal.		

a. Elevated pressure that is equalized through the eustachain tube creates an area of low pressure between the plug and ear drum.

b. This pressure imbalance forces the drum outwards causing pain.

2. A similar air pocket can be formed when the eustachian tube becomes blocked while the diver is on the botton. The result is the same, but this does not occur too often.

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3. Prevention of an external

ear squeeze.

a. Never wear ear plugs.

b. Vent tight-fitting hoods.

c. Assure ability to clear prior to diving.

c. Ear problems will present the majority of medical problems in a diving operations. If such problems occur in sufficient number they could measurably affect successful completion of diving operations.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

5. Face mask squeeze usually caused by:
   a. Failure to equalize pressure in the SCUBA mask by nasal exhalation.
   b. Loss of air supply or malfunction/mishandling of air control valve in the lightweight (Jack Brown) mask.
6. Suit squeeze occurs in dry suit diving when an air pocket is trapped in the folds of the suit.
7. Sinus squeeze.
   a. Anatomically, the sinuses are hollow spaces located

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
within the bones of the skull. 1. Lined with mucous membranes. 2. Connected to the nasal passages through narrow openings ostia that are also mucosa-lined. b. In upper respiratory infections, sinuses may become inflamed, and the ostia blocked, forming an air pocket in the skull. c. These blocked sinuses then react to pressure increases. 1. The mucosa swell, filling the cavity with blood and	Diagram on C/E.	Follow on Pg. 3-19 DV Han Figure 3-17.

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fluid.

2. Pain is intense, and if clearing of the sinuses cannot be affected the dive is aborted.

d. Prevention of sinus squeeze.

1. Halt descent, come up a few feet to clear.

2. Use slower rate of descent.

3. Utilize decongestants & antihistamines prior to diving.

8. Tooth squeeze caused by improper filling or gas pocket.

a. Can be extremely painful.

b. Inform dentist that you

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are a diver and to insure against possible air pocket when filling teeth.

D. Inert gas narcosis.

1. The physiological phenomenon exhibited by (some) inert gases under increased pressure, characterized by an intoxicated condition in the diver.

a. Depth at which narcosis from the inert portion of the breathing media occurs is variable:

1. Specific inert gas.

2. Diver susceptibility.

3. Concentration of inert gas.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

b. Nitrogen narcosis - "Rapture of the deep".

1. Can be expected to occur at 90" or 4th ATM. Absolute.
2. Symptons increase with depth:
   a. 100'-150': Light headedness, increasing self confidence, loss of fine descrimination some euphoria.
   b. 150'-300': Joviality & garrulousness; perhaps some diziness.
   c. 200'-250': Uncontrollable laughter, approaching hysteria. Los of mental

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activity, peripheral numbness & tingling. Inattention to personal safety. Delayed response to stimuli.

d. 250'-300': Depression, impaired neuro-muscular coordination.

e. 300'-350': Anesthetic properties begin to become apparent.

3. Symptons disappear upon return to surface.

a. With excessive exposure to narcosis, amnesia lasting several hours has been seen.

b. Extreme sleepiness is common.

c. Argon has demonstrated increased narcosis activity.

d. Helium narcosis has not been seen even at 2000'.

2. The exact chemical nature of inert gas narcosis is unknown, but there are several theories.

a. Memer-overton.

b. Molecular weight.

Oxygen toxicity: Oxygen in high concentrations is often utilized as a breathing media. However, prolonged exposure to high partial pressures of oxygen can initiate the syndrome known as oxygen toxicity:

1. 0_2 toxicity is caused by increased P.P. of 0_2

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
a. High O_2 concentration.		
b. Depth-even air in excess of 250' poses a hazard. Navy air diving is limited to 297'.	PP O_2 at 250'=1.586 atm PP O_2 at 297'=1.885 atm	
c. A combination of depth plus O_2 percentage.		
2. Toxicity symptoms are preceded by a latent period.		
a. Latent period varies with the individual.		
b. Also varies according to depth and partial pressure of O_2.		
3. There are two types of O_2 toxicity that are of concern to divers.		
a. Pulmonary O_2 toxicity can be		

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expected to occur from depth of 20' to 53'. (0.6 atm to 1.6 atm)

1. Symptoms include, lung irritation, fluid production and cellular damage. Deaths have occured.
2. Exposure times that would result in this form of O_2 toxicity are quite lengthy, and depth-dependant.

b. CNS oxygen toxicity is the form that is most often seen in divers and high-pressure workers.

CNS - Central Nervous System

1. Occurs usually in excess of 53', but has been seen as shallower depths in susceptible individuals and un-

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
usal conditions.		
2. CNS toxitity occurs generally before pulmonary symptoms are seen.		
3. Symptoms are principally CNS manifestation and can be entirely absent or unnoticed and the diver go directly into convulsions (grand mal seizure).	Explain V.F.N.T.I.D. acronym V - vision F - pain N - nausea T - twitching I - irritability D - dizziness	Copy in notes.
a. Muscular twitching, mainly in the facial muscles around the lips & eyes.		
b. Nausea, which may be		

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mild & intermittent, & can go unnoticed by inexperienced personnel.

c. Dizziness - may go unseen in resting diver.

d. Visual or hearing disturbances such as tunnel vision or ringing in the ears - tinnitus.

e. Anxiety, confusion or irritability - marked mood changes in the diver.

f. Usual fatigue.

g. Lack of coordination

4. It must be remembered that

these are only symptons and signs of oxygen poisoning. The most important result of this danger is the convulsion. Death has not occured in humans, as the problem is remedied prior to its happening.

c. Treatment of O_2 toxicity.

1. Reduce the partial pressure of O_2 to the diver.
   a. Remove the mask.
   b. Decrease the depth of the diver.
2. If the diver goes into convulsions, all that can be done is reduce the partial

pressure and prevent him fom injuring himself.

a. Restrain him if necessary.

b. Prevent him from biting his tongue.

c. Allow convulsion to subside.

d. Prevention of O_2 toxicity in divers.

1. Knowledge of the dangers.

2. Proper training.

3. Adhere to the oxygen diving table (Table 13-2) when using 100% O_2 for diving.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
F. Carbon dioxide toxicity can be defined as an excess of CO_2 in the tissues which is the result of either a build-up or an excess of CO_2 in the divers air supply.	Place on C/F: "HYPERCARBIA"	
1. Causes of CO_2 build-up include:		
a. Inadequate ventilation.		
1. Insufficient air flow in MK V or lightweight diving gear.		
2. Controlled breathing in SCUBA.		
b. The increased metabolic production of CO_2 due to over-activity on the bottom.		
c. Contamination of the breathing		

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media.

d. Failure of CO_2 absorbent.

1. MeO_2 absorbent failure (baralime).

2. Closed & semi-closed circuit SCUBA's.

The progression of the toxic build up in the body generally follows these steps:

a. Inadequate ventilation (for whatever reason).

b. Produces CO_2 excess in diver's dress, mask, or mouthpiece.

c. This results in an increased partial pressure of CO_2 inhaled by the diver;

d. Elevating the amount of CO_2 forced into solution in the

bloodstream (Henery's Law).

e. Overactivation of CO_2 chemoreceptors.

f. Causes excessive respirations that more rapidly accelerate the "PCO_2" or the quantity of CO_2 dissolved in the blood.

g. Now, a rapid reduction in the amount of CO_2 (that is metabolically produced) being carried away from tissues begins.

h. The resultant CO_2 excess at the cellular level of the brain begins to dis-

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play CNS type symptoms.

i. Since the tissues are not O_2 starved, removal of the cause of the toxicity results in a reversal of the symptoms.

3. When controlled breathing is the reason for inadequate ventilation; metabolically produced CO_2 cannot be eliminated at the rate it is being produced. This produces the excess in the bloodstream.

4. Excessive breathing resistance can cause an increase in metabolic CO_2 production that is not exhaled at the same rate as it is produced.

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a. SCUBA regulator set to "Heavy".

b. Excessive dead space in the diver's equipment.

5. It has been shown that experienced divers have involuntarily "subdued" their CO_2 chemoreceptor sensitivity.

a. May have retarded response to CO_2 levels.

b. Possibly greater hazard than that faced by a non-diver.

6. Symptoms of CO_2 toxicity include but are not limited to these:

a. Rapid shallow respirations.

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b. Confusion, disorientation.

c. Inability to think clearly.

d. Loss of consciousness.

e. Generalized convulsions.

f. Death can result from cell damage.

g. Symptoms are not reliable. Most common is respiratory distress.

h. Frequent sign of impending CO_2 build-up is a "foggy" faceplate.

7. Treatment of mild CO_2 toxicity consists of removal of the source of the offensive gas.

a. Resuscitation with O_2 in more severe cases.

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b. Consider a Table 5.

8. While CO_2 toxicity-hypercapnia presents less of a hazard than hypoxia, it can present the diver with other potential dangers.
   a. Increased susceptability to decompression sickness and nitrogen narcosis.
   b. The danger of initiating oxygen toxicity is a possibility.

9. Hypoxia is the general term applied to the condition that arises as a result of a lack of oxygen to the tissues; a breakdown in the oxygen transport mechanism, or a cellular failure to use the O_2 transported to tissues.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

1. Causes of hypoxia, include:
   a. Airway obstruction or restriction.
   b. Insufficient oxygen in the diver's breathing media.
      1. O_2 partial pressure to the diver must be 0.16 ATM (2.532 psi) or hypoxia will begin.
      2. O_2 partial pressure of 0.14 (2.058 psi) will produce:
         a. drowsiness.
         b. Inability to think clearly.
         c. Mild euphoria.
         d. Loss of fine muscle control.

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1. O_2 partial pressure of 0.12 ATM (1.764 psi) will produce:
4. O_2 partial pressures of 0.10 to 0.06 ATM (1.470 to 0.882 psi) will produce a ft. unconsciousness: any partial pressure of O_2 below this level will be rapidly fatal.

c. Diseases of the lungs and accessory breathing apparatus, such as:
   1. Pneumonia.
   2. Polio (breathing muscles).
   3. Tuberculosis, etc.

d. Blood diseases or conditions

which interfere with the O_2 transport mechanism include:

1. Carbon monoxide poisoning.
2. Anemias.
3. Cyanide poisoning.
4. Leukemia, etc.

e. Interferance with blood circulation.

f. Toxic conditions within the body tissues which can prevent utilization of oxygen at a cellular level.

1. Chemical poisoning.
2. Disease processes that inhibit cellular function.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. While the partial pressure of O_2 in the diver's media must not fall below 0.16 ATA, it must not exceed 1.6 ATA, or oxygen toxicity becomes a danger.		
a. 1% at 495' will yield a partial pressure of 0.16 ATA.	On C/B $\frac{(495 + 33)}{33} \times 0.01 = 0.16$	
b. 10% O_2 at this depth = 1.6 ATA and a dangerous O_2 level.		
3. Symptons include:		
a. Rapid, full pulse.		
b. Elevated blood pressure.		
c. Rapid breathing.		
d. Respiratory distress.		
e. Pale skin.		

f. Blue color in lips, skin, and fingernails - cyanosis.

NOTE: Not in CO toxicity.

4. Treatment.

a. Artificial resuscitation.

b. Maintain airway.

c. Administer O_2.

d. Consider Table 5.

5. Prevention of Hypoxia in divers consists principally of alertness to conditions and situations that are capable of depriving the diver of oxygen.

a. Air or media loss.

b. Tracheal blockage.

c. Insufficient or incorrect O_2% in breathing media.

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B. Carbon monoxide toxicity in divers is usually the result of contaminated

breathing media.

1. Sources of contamination include:

   a. Compressor exhaust located too near the air intake.

   b. Wind shift that blows the exhaust (or stack gas) into the intake.

   c. Improper lubricating oils used in the compressor. The only oils currently authorized are:

      (1) 2190T - until supplies exhausted

      (2) 2135th - replaces 2.90T

      (3) Prime oil "D"

      (4) Castor oil.

2. Physiological action of CO consists of the hypoxic effect of the gas.

   a. Combines with hemoglobin 200 times more readily than with O_2.

   b. Replacement of the O_2 on hemoglobin produces hypoxia.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

3. Very low concentrations can cause symptoms.

   a. Concentration of 0.002 ATA can prove fatal. (.002% by volume).

   b. Low concentrations absorbed over a long period of time are equally as dangerous as high concentration due to continuous displacement of O_2.

4. Theoretically, depth has no effect however, under pressure oxygen will be forced into solution in blood plasma, providing cells with necessary O_2. As the pressure of O_2 is reduced, tissue hypoxia begins due to lesser partial pressure. Diver may become unconscious during ascent.

5. Due to the chemical nature of the the toxicity, lower concentrations of CO produce more predictable symptoms than are normally seen in hypoxia and hypercapnia.

   a. Tightness across forehead.

   b. Headache, from mild to severe.

   c. Nausea.

   d. Confusion

e. Unconsciousness.

f. Death.

6. Treatment is essentially the same as for hypoxia and hypercapnia

a. Table 5 is very desirable.

b. Resusitation.

7. Since the mechanism is chemical, in this case it is reversable, provided treatment begins prior to any extensive amount of tissue damage, particularly the brain, occurs.

I. Asphyxia is defined as the conditions of hypoxia and hypercapnia at the same time.

1. Causes of asphyxia include:

a. Strangulation - the blockage of the airway due to trauma or mechanical blockage.

b. Suffocation.

c. Drowning.

d. Respiratory paralysis.

2. The CO_2 build-up and O_2 starvation is certain if the source is not alleviated promptly.

3. Symptoms are essentially the same as for hypoxia.

4. Treatment of asphyxia involves principally resusitation coupled with removing causative factors.

II. Decompression sickness.

A. Can be most simply and understandably defined as the condition arising as a result of insufficient decompression following sufficient exposure to pressure. Historically, decompression sickness has been with us since Siebe developed the diving dress and Trigger invented the Caisson. Many attemps have been made to deal with this malady, and todays general concept is one of, first; prevention of the disease through correct application of decompression schedules; secondly for those who have contracted the disease, is treatment by recompression and oxygen utilization.

B. Etiology of decompression sickness.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

1. At sea level the human blood and tissue level of nitrogen from the air amounts to about 0.8 ATA (partial pressure). This level is the same throughout the entire body. We are nitrogen-saturated at sea level.

2. With the application of higher partial pressures of N_2, as in diving or any hyperbaric activity more nitrogen is dissolved in the blood and tissues (Henry's Law).

   a. The rate of absorbtion by the body is essentially depth and time at depth dependant.

   b. Other factors also influence the total amount of nitrogen or other inert gas being absorbed.

      (1) Water temperature - cold water tends to enhance N_2 absorbtion.

      (2) Diver physical activity plays an important role. The more active the diver, the more blood circulates through the body and correspondingly greater ...

amounts of gas are absorbed.

(3) Physical condition of the diver can influence the rate of gas absorbtion. The tired, exhausted diver having a greater gas uptake than the healthy, rested diver.

(4) Dives less than one atmosphere in depth (33') do not result in decompression sickness within practical diving limits.

3. As long as the diver is on the bottom, he is in no danger from the bends.

4. Dives less than one atmosphere in depth (33') do not result in decompression sickness within practical diving limits.

5. Upon ascent, the absorbed inert gas in the tissues, has a hightar partial pressure than the circulating gas, and effects a reversal of Henry's Law, forcing the absorbed nitrogen out of the tissues.

Soda pop anology

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a. Normally the N_2 will leave the body via the lungs.

b. If ascent is too rapid, or decompression is omitted, the gas may form bubbles in veins.

c. The bubbles can clump together (ago-regate), grow larger and venous flow to the lungs becomes hindered.

d. This tends to accelerate the further formation and growth of bubbles, which may then lodge in a vessel, starve blood flow, and cause symptoms.

e. The most common site of bubble location is in the joints.

6. Generally, the seriousness of decompression sickness is dependant upon the size, number, and location of the bubbles.

C. Diagnosis of decompression sickness involves carefully evaluation of several factors.

1. Such evaluation of possible bends cases should be conducted by the best qualified individual present.

2. Do not delay making the diagnosis by awaiting the arrival of "more qualified" personnel.

3. Decompression sickness usually occurs shortly after the diver reaches the surface.

   a. 50% within 1st 30 min.

   b. 85% within 1st hour.

   c. 95% within 3 hours.

   d. 1% delayed more than 6 hours.

4. The frequency of symptoms follows the following pattern, although it is almost impossible to accurately predict the onset & location of decompression sickness.

   a. Local pain symptoms -89%

      (1) Legs - 30%

      (2) Arms - 70%

   b. CNS bends symptoms - 11%

      (1) Dizziness (Staggers) 5.3%

(2) Paralysis 2.3%

(3) Chokes (respiratory distress) 1.6%

(4) Extreme fatigue and pain 1.3%

(5) Collapse and unconsciousness 0.5%

c. It is noteworthy that true cases of brain involvement in decompression sickness are relatively rare, due to the pathway through both sides of the heart and lungs fields - bubbles must travel to give true brain symptoms.

5. Since decompression sickness and air embolism have many symptoms in common, the biggest factor separating the two is time of onset.

D. Pain only decompression sickness often begins with a feeling that "something is wrong".

1. Progresses from mild pain and can become unbearable.

2. Pain feels as if it is in the bone or deep within a joint.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

3. This pain is usually unaffected by massage or mild movement.

4. Can be aggravated or made worse by hot soaks, showers, baths or localized heat.

5. In addition to pain, these other symptoms may be present, either alone or in combination.

   EXPLAIN
   P ain
   I tching
   S welling
   S kin rash

   a. Itching that is unrelieved after 30 min. on surface.

   b. Swelling.

   c. Skin rash.

6. Do not give affected diver any drugs to help the pain. It will confuse treatment.

7. It may be difficult to decide if a diver has pain only bends if he has experienced trauma underwater.

   a. However, trauma can mean increased blood flow to a particular area, with a greater uptake of N_2.

b. Always resolve any doubt in favor of the diver if in doubt-treat.

8. Abdominal or trunk pain is not simple bends.

a. Easily confused with gas pains.

b. May be CNS involvement, so treat it as a serious symptom.

E. CNS Symptoms of decompression sickness generally include any other symptom presented once air embolism has been ruled out.

1. Treatment of CNS symptoms must be initiated quickly, as they may progress to incapacitation or permanent injury.

2. CNS Symptoms include:

a. Weakness of muscles.

b. Paralysis.

c. "Pins and needles" sensation.

d. Vertigo or dizziness.

e. Visual disturbances.

(1) "tunnel vision"

(2) Blurred vision

f. Hearing disturbances.

(1) Ringing in ears (tinnitus)

(2) Hearing loss.

g. Collapse and Unconsciousness.

h. Chokes or difficulty in breathing.

3. It must be emphasized that treatment must be started as soon as the evaluation or diagnosis of a serious symptom is made. Delay may result in permanent damage or a fatality. Do not wait for medical assistance. If necessary complete examination of the patient at treatment depth.

F. Treatment of decompression sickness involves the application of recompression and the administration of oxygen and slow decompression.

1. Initial recompression is to reduce bubble size.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

2. The administration of O_2 is preferred method of degassing the blood and tissues.

3. Air treatment is to be utilized only in the event O_2 is unavailable, or for some other reason, cannot be administered safely.

   a. Casualty to O2 system during treatment.

   b. Oxygen tolerance test has not been given, and PT may have trouble with oxygen - civilians.

4. Removal of bubbles restores blood flow to affected tissues and the oxygen increases the outward gradient of N_2.

5. General treatment rules.

   a. Treat promptly.

   b. Do not delay treatment.

   c. If in doubt, treat.

   d. Follow treatment schedule accurately.

   e. Hold diver 6 hrs after treatment; 24 hrs if prompt return cannot be assured.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

III. The unconscious diver.

A. An unconscious diver presents an emergency situation that requires prompt remedial action by topside personnel. There are three periods during and after a dive when such a situation may arise.

1. While on the bottom.

2. From leaving the bottom to within 5-10 min. after surfacing.

3. 10 min to 24 hrs after reaching the surface

B. Diver unconsious on the bottom.

1. May result from a number of reasons.

a. Loss of air supply.

b. Hypercapnia

c. Carbon monoxide toxicity.

d. Oxygen toxicity.

e. Asphyxia.

f. Hypoxia.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

2. Regardless of the cause, immediate action is necessary.

   a. If diver is in deep sea gear and communication is lost:

      (1) Try hand signals, check phones, look for bubbles.

      (2) Send down standby diver or use another diver on the bottom to check.

      (3) Bring affected diver to his 1st stop at 60 FPM and attempt to regain communication. If he remains unconscious, judgement is needed in order to decide next move. Remember you cannot help the diver until he is on the surface.

         (a) Consider depth.

         (b) Consider time at depth.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACCTIVITY
(c) Weigh consequences of possible " "explosive decompression against an unconscious and possible not breathing diver.		
b. An unconscious scuba diver on the bottom most likely will not be subject to explosive decompression due to design limitations of the equipment.		
(1) Bring the diver up to the surface at 60 FPM.		
(2) Resuscitate with oxygen or mouth to mouth methods.		
(3) Observe for signs of bends or air embolism.		
c. A light weight diver will generally not be working at extreme depths. The considerations for the diver in "Jack Brown" or KMB are the same as for a scuba diver.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

C. A diver who becomes unconscious during ascent, or within 5 min. of arriving on the surface.

1. Can be suffering from any of the following.

a. Air embolism.

b. Massive decompression sickness.

c. Carbon monoxide poisoning.

d. Carbon dioxide poisoning.

e. Asphyxia.

f. Hypoxia.

2. All of the above conditions can be most effectively handled by recompressing the diver at once to a depth appropriate to the symptoms presented.

3. However, it is much safer to consider the diver to be suffering from the most severe malady, air embolism, and treat accordingly.

D. The diver who becomes comatose from 10 min. to 24 hrs after surfacing.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDY ACTIVITY

1. Causes may include:

   a. Air embolism.

   b. CNS Decompression sickness.

   c. Traumatic injury suffered while on the bottom.

2. After 5-10 min. on the surface, it is unlikely that the diver will be suffering from air embolism. However, it must be considered as a possibility up to 10-15 min. after a dive.

3. The most likely cause for the diver's condition is CNS bends, if other explanations. for his unconsciousness are not available.

NAVAL SCHOOL DIVING AND SALVAGE

SCUBA Diver, A-433-0023

Security Classification: None

Lesson Topic 3.5 Diving Disease/Injury Treatment
Part III

4 Hours

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual, Vol. I

Standard Classroom Equipment

Student Guides

Overhead Projector

Transparencies

Reference: Physiology and Medicine of Diving,
Bennett and Elliott

TERMINAL OBJECTIVE

1. When the student completes this course, he will be able to, given a hypothetical case involving a disease/injury/condition common to diving, describe, in a sequence of steps, appropriate actions. Include, as a minimum, name of disease/injury/condition, selection of proper treatment table, if appropriate, treatment and post treatment actions. If treatment tables are necessary, make correct log entries.

ENABLING OBJECTIVES

1. Treatment Tables:

   a. Orally LIST the tables used in recompression treatments (except saturation).

   b. EXPLAIN, in writing, the application of selected equipment and devices used in recompression treatment.

   c. DEFINE, in writing, selected terms used in recompression treatment.

   d. Given selected conditions, DESCRIBE, in writing, the sequence of steps for treatment.

   e. EXPLAIN, orally, the need for recompression treatment and treatment tables.

ENABLING OBJECTIVES (CONT'D)

f. Orally DESCRIBE the fundamentals involved in selecting the proper treatment tables.

g. DESCRIBE, in writing, the symptoms of oxygen poisoning.

h. DESCRIBE, in writing, the most frequent errors related to treatment.

i. Orally DESCRIBE the fundamentals involved in recompression treatment in the water.

j. DESCRIBE, in writing, the most vital features of hyperbaric chamber use.

k. Orally DESCRIBE the two basic types of treatment tables.

l. DESCRIBE, in writing, the precautions that must be taken when transporting divers requiring decompression treatment.

m. Orally DESCRIBE the decompression of treatment tenders.

n. EXPLAIN, in writing, the function(s) of the components below in terms of what it does for the system; source of information required for its use; describe the components; and explain the application or uses:

(1) Treatment table for decompression sickness and air embolism.

(2) Treatment table for minimal recompression O^2 breathing.

o. For each treatment table component (section), DESCRIBE, orally, the physical location and application or use.

p. Given the following, STATE, the setpoint (s) and reasons for the setpoint(s) in terms of the effects of operating above or below them.

(1) Rate of ascent of each table.

(2) Rate of descent for each table.

(3) time/depth limits for each table.

q. Orally DESCRIBE the effect on the treatment table system due to the Hyperbaric Chamber system.

r. Orally DESCRIBE the safety precautions unique to the treatment table system.

(1) Accurate time and record keeping.

CRITERION TESTS

Given three hypothetical cases involving disease/injury/conditions common to diving, describe, in a sequence of steps, appropriate actions. Include, as a minimum, name of disease/injury/conditions, selection of proper treatment table, if appropriate, treatment and post treatment actions. If treatment tables are necessary, make correct log entries.

HOMEWORK

Volume A, Student Guide:

Day 2 - Assignment Sheets 3-5-17A through 3-5-20A

Day 3 - Assignment Sheets 3-5-21A through 3-5-27A

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

1. General considerations of treatment.

   A. Oxygen is the preferred breathing media for all treatments where recompression is indicated.

      (1) Extensive research and over 10 years of practical experience in treating cases of decompression sickness and air embolism have proven the superiority of oxygen for treatment.

      (2) The air treatment tables have a high rate of failure:

      a. 1A = 1.5%

      b. 2A = 3.2%

      c. 3 = 22%

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d. 4 - 25%

(3) The theoretical basis for treatment is a two phase approach.

a. Initial repressurization to treatment depth to eliminate or reduce bubbles.

(1) 60' depth for tables 5 and 6

(2) 100' for Table 1A'

(3) 165 for 2A, 3,4, 5A and 6A.

b. Second phase involves removal of all absorbed inert gas by slow ascent.

c. The oxygen tables features the return to 60' for use of oxygen.

(1) Eliminates additional inert gas uptake or absorbtion.

(2) Dramatically increases the outward partial pressure gradient of tissue and blood inert gas.

(3) Encourages normal elimination of dissolved gases through the lungs.

B. The schematic (flow chart) approabh to treatment.

(1) Starts with two basic facts:

a. Divers complaint

b. History of exposure to pressure.

(2) A diagnosis may now be made.

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a. The diver has a treatable injury or he does not.
   (1) Any doubt must be resolved in favor of the diver by treating him.
   (2) Such a decision to treat should be made by the most qualified person present on the scene.

b. The treatable injury must fall into one of three categories:
   (1) Pain only bends.
   (2) Serious symptoms of decompression sickness.
   (3) Air (Gas) embolism.

c. If a diving medical officer

is not on station for treatment of a serious symptom or gas embolism it is desirable to contact one of the following:

(1) Nearest diving medical officer

(2) Navy Experimental Diving Unit

(3) Naval School Diving & Salvage

d. Do not delay treatment waiting for Medical assistance.

(3) Once symptoms have been categorized, the most vital point of treatment is now

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considered: the availability of oxygen.

a. If oxygen is available.

(1) Treat pain only bends on Table 5 or 6 depending on time of relief at 60'.

(2) Treat serious symptoms of decompression sickness on Table 6.

(3) Treat gas embolism on 5A or 6A depending on time of relief or moderation.

(4) Avoid committing a patient to the air tables unless there is not relief at 60' for bends or

no deceleration of gas embolism symptoms at 165'.

b. If 0^2 is not available for treatment, or for some reason cannot be used:

(1) For pain only bends, use 1A or 2A depending on depth of relief.

(2) For serious symptoms or gas embolism use table 3 or 4 depending on time of relief of symptoms.

(4) This approach and these guide lines will cover the first 30 minutes of treatment.

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a. In most cases relief will be obtained.

b. Bubbles will be reduced or eliminated.

c. The appropriate treatment table will have been selected.

2. Oxygen breathing treatment tables.

A. Treatment Table 5 - 135 minutes.

(1) Used for pain only bends that are completely relieved within 10 min. at 60'.

(2) Start oxygen breathing on the surface.

(3) Descent rate is 25 FPM, breathing 0_2.

(4) Oxygen breathing time is two 20 min. periods, se-

1085

parated by 5 min. of air.

(5) If oxygen toxicity symptoms develop, use the following procedure:

a. Remove the mask, and wait for all symptoms to subside.

b. Wait an additional 15 min.

c. Resume schedule at the point of interruption.

d. Repeat as often as symptoms are displayed.

(6) Rate of ascent is one foot per minute breathing O_2, to 30 feet.

(7) If the patient displayed O_2 symptoms at 60 ft.,

1086

upon arrival at 30 ft. utilize the 30 ft. schedule for Table 6.

(8) Travel from 30' to the surface is at one foot per min.

(9) Retain the patient for 6 hours close to the chamber in case of a recurrance.

(10) Tenders during oxygen treatment.

a. Must be qualified tender inside the chamber during treatment.

(1) Diving HM.

(2) First Class Diver

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b. Tender breaths chamber air throughout the treatment unless the treatment constitutes a repetitive dive for the tender, in this instance, he breaths O_2 for the last 30 min. of ascent.

B. Treatment Table 6 - 285 minutes.

(1) Used for pain only bends that is unrelieved in 10 min at 60 ft.

(2) Used for all serious symptoms except gas embolism.

(3) Descent time is 25 FPM unless PT is in serious distress.

a. Start O_2 on the surface & during descent.

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b. Handle oxygen symptoms the same as for Table 5.

c. Ascent time is one FPM.

(4) Same rules apply to the tender.

(5) Table 6 may be lengthened.

a. 20 min O_2 and 5 min air at 60'.

b. 60 min O_2 and 15 min air at 30'.

c. Either or both may be used.

C. Treatment Table 5A - 154 minutes.

(1) Used only for gas embolism symptoms that are relieved within 15 min at 165'.

(2) Rate of descent is as fast as possible.

a. Remain at 165 the full 15 min.

b. All symptoms must be clear before electing to use Table 5A.

(3) Ascend from 165' to 60' at 26 FPM or in 4 minutes.

(4) Upon arrival at 60', commence breathing 0_2 as per schedule on 5A.

(5) From 60' to 30', and 30' to surface use on foot per minute.

(6) Handle 0_2 symptoms the same as for Table 5 - switch to 6A at 30' for any 0_2 symptoms encoutered at 60' on 5A.

(7) Tender follows same rules as for Tables 5 and 6.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

D. Treatment Table 6A - 319 Min.

(1) Used only for treatment of gas embolism symptoms that have moderated within 30 min. at 165'.

(2) Rate of descent is as fast as possible.

a. Symptoms must show positive signs of clearing prior to 30 min. at 165'.

b. No moderation of symptoms commits patient to treatment Table 4.

(3) Ascend from 165' to 60' at 26 FPM or in four minutes.

(4) Upon arrival at 60', go on oxygen.

(5) Remainder of treatment is the same as for Table 6.

(6) Tenders follow same procedure as on 5, 6, and 5A.

(7) Oxygen toxicity symptoms are treated the same as Tables 5, 6, and 5A.

(8) Table 6A may also be lengthened.

a. 60 min O_2 and 15 min air at 60'.

b. 20 min O_2 and 5 min air at 60'.

c. Either or both may be used as thought necessary.

3. Air treatment Tables.

A. Not effective in treating decompression sickness or gas embolism

1092

as oxygen should be used only if:

(1) Oxygen is not available.

(2) Oxygen therapy is not indicated.

a. PT known to tolerate oxygen poorly.

b. PT has not had O_2 tolerance test; civilians

NOTE: In either case, diving MO may authorize O_2.

(3) Failure of O_2 system during treatment.

(4) Water treatment.

(5) Treatment situations where oxygen therapy has failed to relieve symptoms.

B. Table selection depends on symptons.

(1) Pain only bends symptoms.

a. Table selection depends on depth of relief rather than time of relief as on O_2 tables.

b. Tables 1A and 2A are used for pain only decompression sickness.

(2) Serious bends symptoms and gas embolism.

a. Treated on Tables 3 or 4.

b. Selection depends on time of relief at 165'.

c. Gas embolism symptoms are handled in the same way as serious decompression sickness.

C. Table 1A - Pain only bends.

1094

(1) Depth of relief must be less than 66'.

a. Descent rate is 25 FPM.

b. Ascent rate is one min. between stops.

(2) Time at 100' includes descent time.

(3) Also used for omitted decompression.

(4) Not used for air embolism.

D. Table 2A - Pain only bends.

(1) Treatment depth is 165'.

a. Descent rate is 25 FPM.

b. Ascent rate is one min. between stops.

(2) Time at 165' includes descent time.

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(3) Not used for air embolism.

(4) Used when symptoms do not clear prior to 66'.

(5) If pain only sumptoms are not relieved after 30 min at 165' complete table 2A.

a. Do not extend time at 165'.

b. PT may not have decompression sickness.

c. There may be residual or permanent damage causing the pain.

E. Table 3 - Serious bends or gas embolism.

(1) Treatment depth is 165'.

a. Descent rate is as fast as possible.

b. Ascent rate is one min. between stops.

(2) Used if symptoms are relieved within 30 min. at 165'.

(3) Time at 165' includes descent time.

(4) Symptoms unrelieved after 30 min. at 165' use Table 4.

F. Table 4 - Serious bends or gas embolism.

(1) Treatment depth is 165'.

a. Descent rate is as fast as possible.

b. Ascent rate is one min. between stops.

(2) Time at treatment depth includes travel time.

(3) Time spent at 165' is variable.

1097

a. Must be at least 30 min.

b. Must not exceed 120 min.

c. Anytime after 30 min. PT may be brought up, providing relief is complete.

(4) If symptoms are unrelieved, or relief is incomplete after 120 min. bring him out on Table 4.

a. May not have bends.

b. May have permanent damage that will not benefit by more time at 165'.

G. Omitted decompression. This occurs when the diver comes to the surface at a rate faster than 60 FPM, missing his scheduled decompression stops.

(1) Can be caused by any of the following:

1098

a. Blow-up

(1) MKV

(2) NaO_2 Rig

b. Loss of air supply.

c. Injured or unconscious diver.

(3) On a dive requiring decompression stops:

a. Use surface decompression

(1) Only if all water stops have been completed.

(2) Or if no water stops were required on the applicable sur "D" table.

b. Use Table 5.

c. Use Table 1A if O_2 is not available.

d. Observe diver closely for signs & symptoms of the bends.

1999

(4) If the diver has symptoms upon arrival treat him accordingly.

(5) If no chamber is available, use Table 1A in the water.

a. Water treatment is a last resort.

b. Normally, seek the nearest chamber even at a great distance.

(6) If water depth is insufficient for Table 1A:

a. Use standard air decompression Table for depth & time of the dive.

b. Repeat all stops deeper than 40'.

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c. Take one min. between stops.

d. At 40' remain for 1/4 of 10' stop time.

e. At 30' remain for 1/3 of 10' stop time.

f. At 20' remain for 1/2 of 10' stop time.

g. At 10' remain for 1 1/2 of 10' stop time.

(7) Use deep sea rig (MK V)

H. Use of Helium-Oxygen mixtures in treatment.

(1) Utilization of HeO_2 is desirable when:

a. Symptoms are slow to clear.

b. PT has difficulty breathing.

(2) HeO_2 mix may be used in place of air not O_2.

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(3) Use 80-20 mixture only.

4. Recurrances. Can be defined as the reappearance of any symptom(s) of decompression sickness or gas embolism, either during or after treatment.

A. General considerations.

(1) A recurrance is evidence that the original course of treatment was insufficient, and may be due to any number of reasons.

a. Table selected provided insufficient time for complete bubble elimination.

b. Depth of selected Table was unsufficient to reduce bubble size.

c. Possible error in treatment.

(1) Delay by the diver in reporting

1102

his symptoms.

(2) Failure by diver to report all his symptoms.

(3) Failure of treatment personnel to recognize serious symptoms.

(4) Delay in getting diver to treatment.

(5) Failure to treat adequately.

(2) In Navy divers, working in the Naval Diving environment, recurrances are relatively rare.

a. Generally, Navy divers are a young healthy, and vigorous personnel group.

b. They receive more thorough training in medicine and physics than their

civilian counterparts.

c. Navy diving operations are most often conducted in close conjunction with adequate treatment facilities.

d. Civilian divers, treated by the Navy for humanitarian reasons, contribute the majority of recurrance statistics.

B. Management of recurrances. Current practice indicates that all recurrances are treated on Table 6 or Table 4.

(1) The basic question is whether or not oxygen is available.

a. O_2 available. Treat <u>all</u> recurrances, during and after treatment, on Table 6.

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b. O_2 not available, recurrances

must be handled on Table 4 based on the time of onset.

(1) Recurrance during treatment go to 165', use full Table 4.

(2) Recurrance following treatment go to depth of relief, 165'maximum and bring PT out on Table 4 from that point.

(2) Recurrances of gas embolism are also treated on Table 6 (or4), vice 6A.

(3) Bring patient out on 6 (or 4) regardless of relief of symptoms. Further delay in getting the patient to hospitalization is detrimental. Condition probably semi-permanent.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(4) Do not take PT from table 6 to table 4 to treat unresponsive recurrance.		

NAVAL SCHOOL DIVING AND SALVAGE

SCUBA Diver A-433-0023

Security Clearance: None

Lesson Topic 3.6 Dangerous Marine Life

1 Hour

INSTRUCTIONAL MATERIAL:

U.S. Navy Diving Manual, Vol. I

Standard Classroom Equipment

Student Guides

Overhead Projector

Transparencies

16mm Projector

Film #9810697, "Dangerous Marine Life"

References: 1. NAVSTP 324, Handbook of Dangerous Animals for Field Personnel

2. Poisonous and Venomous Marine Animals, Halstead, 1965

TERMINAL OBJECTIVE

1. When the student completes this course, he will be able to, given pictures/illustrations of marine life, identify with correct name, describe danger (if any) to divers, describe, in a sequence of steps, appropriate medical actions and precautions to avoid contact.

ENABLING OBJECTIVES

1. For each of the following species, DESCRIBE, in writing, the physical characteristics, habitat and precautions to avoid contact, danger to divers (if any).

   a. Sharks
   b. Barracuda
   c. Groupers
   d. Moray Eels
   e. Killer Whales
   f. Sea Lions
   g. Barnacles and Mussels
   h. Giant Clams
   i. Jelly Fish
   j. Corals
   k. Octopus
   l. Cone Shells
   m. Sea Urchins
   n. Stingrays
   o. Venomous Fish
   p. Sea Snakes

ENABLING OBJECTIVES (CON'D)

2. DESCRIBE, in writing, the procedures for treatment of snake bites, venomous fish stings, stingray wounds and jelly fish stings.

3. DESCRIBE, in writing, the treatment for bites from shark and barracuda.

CRITERION TESTS

1. Given three (3) pictures/illustration of marine life, identify with correct name, describe danger (if any) to divers, describe, in a sequence of steps, appropriate medical actions and precautions to avoid contact.

HOMEWORK

Volume A, Student Guide Information Sheet 3-6-1I; Assignment Sheets 3-6-1A and 3-6-2A.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

I. Sea Snakes

A. General Comment

1. Over 50 different species identified.

a. all are venomous.

b. all should be considered dangerous.

2. Usually found in the western Pacific, but one species ranges from East Africa to Mexico & Central America.

3. To date, no sea snakes have been found in the Atlantic or Mediterranean.

B. Physical Characteristics:

1. All sea snakes have a flat paddle-like tail.

2. They are air breathers and must surface.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
3. Usually are quite colorful with rings or stripes on body and tail.	Show slide or other representation point out physical characteristics.	
4. Extremely agile in the water.		
5. Very few species are amphibious.		
B. Symptoms of Sea Snake bite.		
1. 1/2 - 1 Hour- Generalized aches and pains.		
2. 1-2 Hours- Pain becomes more acute.		
3. Change in victims urine color due to destruction of red blood cells.		
4. Unconciousness.		
5. Respiratory collapse.		
6. Death.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
D. First Aid for Sea Snake bite.	List on C.B. or use transparency.	
1. Do not try to "suck-out" the venom. It is absorbed to quickly.		
2. Immobilize the victim and the affected part.		
3. Apply a tourniquet to block venous flow.		
4. Capture/kill the snake if possible to aid identification.		
5. Only 25% of those bitten show symptoms, wait 1/2 to 1 Hour before beginning antivenom therapy.		
6. Get victim to medical attention at once.		
2. Sharks and Shark Attack.		
A. General Information.		
1. 250 known species of sharks, and 27 of these are proven dangerous to men.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. Sharks exist in all oceans and latitudes, but can be found predominatly in waters between 30°N and 30°S latitudes where water temperature is 70° F.		
3. Since 1958, there have been about 100 reported attacks per year, with an average of 50 deaths.		
a. Shipwreck victims go unreported.		
b. May raise the 50% mortality rate.		
B. Some of the more dangerous species are:	Show slides.	Take notes.
1. Great White Sharks		
2. Mako Shark		
3. Blue Shark		

4. Dusky Shark

5. Tiger Shark

6. White Tip Shark

C. Precautions to avoid contact.

1. Chemical repellants, only marginally effective, but aid morale.

2. Some sharks display territorial perogatives.

a. May aggressively defend a particular area.

b. Definite hazard to a diver who must work in such a area.

3. In shark waters, wear dark, non-reflective clothing (wet suit) that reflects light poorly.

4. The "Shark Screen", a bag-like container has proven most ef-

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
fective in shark waters.	Draw picture on C/B.	
5. No defense is 100% certain.		
D. First Aid for shark bite.	List on C.B. or use	Take note.
1. Handle the victim as you would for massive wound lacerations.	transparency.	
2. Traumatic amputations are likely.		
a. Massive hemorrhage		
b. Utilize tourniquets if necessary.		
3. Treat for shock.		
4. Get victim to medical attention as soon as possible.		
3. Cone shells.	Show slides.	Take Notes.
A. Several species have caused death.		
1. Conus Geographitus - probably the most dangerous - 4 fatalities.		
2. Conus Striatus - 1 Fatality		
3. Conus Textile - 2 Fatalites		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
4. Rough mortality rate of 25% of cases reported in medical literature from 1930 to date.		
B. Location of venomous cones.		
1. Generally in the indo-pacific area.		
2. Heavy concentration in the Phillipenes and Australia.		
3. Those cones dangerous to man are primarily sand or rubble inhabitants.		Take notes.
4. The shell is buried in sand with just the sipiton emerging.		
5. Most injuries occur due to mishandling.		
C. Symptoms of Cone Shell poisoning:	List on C.B. or use transparency.	Take notes as necessary.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

1. Similar to wasp or hornet sting.
2. Numbness around mouth(may include the entire body).
3. Motor Paralysis - nerves.
4. Total Muscular paralysis.
5. Respiratory collapse.
6. Death.

D. First Aid treatment.

1. Mostly Symptomatic.
2. No antivenom currently available.
3. Treat for shock.
4. Artificial Respiration.
5. Get to medical attention.

4. Poisonous Marine Life. Take notes.

A. Methods of poisoning(toxification)

1. Ingestion of poisonous flesh.
   a. Known as ciguatoxic poisoning
   b. Very large number of species involved.

c. Specific species of fish may be dangerous so eat only at certain times of the year.

d. Many Marine animals can be lethal in this way:

1) Polar Bear

2) Walrus, Seals and Sea-lions.

3) Certain shark species

2. Mechanical Poisoning.

a. Usually as a result of stepping on or near the animal.

b. Usually the poison is a defensive weapon of the animal.

1) Stonefish

2) Sting rays

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
c. Certain Animals can inflict painful wounds - fire coral and jellyfish - by just brushing against them.		
B. Poisonous Fish 1. Many species are known to be capable of poisoning humans, usually through poison glands at the base of spines projecting from the backbone. a. Stone fish b. Lion fish c. Scorpion fish d. Weever fish e. Zebra fish f. Toad fish g. Catfish (some species)	Show slides of the various toxic fishes.	Take notes.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. Other species have poisonous glandular secretions that may render their saliva or flesh dangerous to humans.		
a. Lamprey		
b. Moray Eel		
c. Hagfish		
d. Trigger fish		
3. Treatment of this type of toxicity consists of:	List on C.B. or use transparency.	Take notes.
a. Ice water soaks to delay absorbtion of venom.		
b. In severe envenomations, a tourniquet may be indicated.		
c. Treat for shock.		
d. Get to medical attention.		
C. Sting Rays. Almost all Species		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
possess a well-developed stinging appartus, and many of these also inject a venom into the wound. 1. Approximately 1500 cases of stingray "Attack" each year. a. Rays bury themselves in shallow, sandy bottoms. b. Most victims are waders who step on the ray and are stung in the lower leg or foot. 2. Symptoms. a. Puncture or laceration. b. Pale, ashen skin, later cyanotic . c. Swelling. d. Tissue necrosis. e. Vomiting, diarrhea.	Show slides of various rays.	Take notes.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
f. Muscle paralysis & Death (Rare).		
3. First Aid.	List on C.B. or use	Take notes.
a. Immobilize affected part.	transparency.	
b. Treat for shock.		
c. Transport victim to medical aid,		
D. Jellyfish. A general term applied to several coelenterates.	Show slides of jellyfish.	
1. Many species can be harmful and a few have caused fatalities.		
a. Sea Wasp	Sea wasp in Halstead Plate	
b. Portugese Man-of-war	XXX Vol I.	
c. Various Hydroids		
d. Sea Anenome		
2. Mechanism of invenomation is via many small nematocysts		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
contained in the long trailing tentacles that come in contact with the victim and poison on contact.		
3. Found in all temperate waters. The portugese man of war has an inflated bladder that floats and the tentacles may trail 15 or 20 ft.		
4. Symptoms - Vary somewhat according to species but follow a general pattern.		Take notes.
a. Stinging, burning sensation.		
b. Red welt, which may form blisters, at points of contact with tentacles.		
c. Muscle & abdominal cramps.		
d. Abdominal rigidity.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

e. Loss of sensation of touch and temperature.

f. Nausea, vomiting.

g. Respiratory distress.

h. Dilerium, convulsions & death.

5. First Aid. No specific antidote for exists for this type of toxicity. Some remedies work in some areas and not in others. — List on C.B. or use transparency.

a. Hot soaks may destroy some poison of smaller jellyfish.

b. Meat tenderizer has occasionally proven of value.

c. Antihistamines - aztifed, benecryl may be effective.

d. Treat for shock.

e. Get to medical attention.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
E. Poisonous Coral.	Show slides of corals.	Take notes
1. A few Varieties of Coral are known to inflict painful stings in victims that merely touch or brush against them.		
2. Such wounds are slow to heal.		
3. Two such varieties are:		
a. Fire coral		
b. Elic horn coral		
4. Symptons are an immediate stinging sensation, welt formation and itching.		
5. Left untreated, the wound may ulcerate, and complications arise.		
a. Cellulitis		
b. Lymphangitis		
c. Swelling of affected part.		
d. Lymph glands become swollen.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
e. Fever & malaise are common.		
6. Extreme pain may become a complicating factor where a small leg scratch will render the victim unable to walk for weeks. Pain is out of proportion to the injury.		
7. First Aid	List on C.B. or use transparency.	
a. Cleanse wound thoroughly.		Take notes.
b. Use an antiseptic.		
c. Seek medical attention.		
F. Sea Urchins.	Show slides.	Take notes.
1. Little is known of the venemous nature of these animals, except that there are about 30 species that apparently possess a venom apparatus.		
2. The prevention of sea urchin		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
poisoning revolves around avoidance. a. Do not handle any sea urchin with spines. b. Leather, rubber or canvas gloves afford little or no protection. 3. Sea urchins are found in almost all oceans, but predominate in tropical seas. 4. Symptoms of toxication include: a. Intense burning and pain. b. Partial motor paralysis. c. General paralysis up to 6 hours. d. Respiratory distress. e. Deaths have been reported. 5. Treatment - First Aid.	List on C.B. or use transparency.	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
a. Mostly symptomatic. b. Do not attempt to remove spines. c. Remove victim to medical aid.		
G. Octopus	Show slides.	Take notes.
1. Most of the species of octopus possess a venom apparatus in their salivary glands. One death in a diver reported. 2. Octopi inhabit almost all oceans of the world. 3. Normally shy and retiring animals, they will flee when approached. a. Will swim away in a cloud of "ink." b. Most bites occur as a result of careless handling.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
4. Most bites are mild in nature, producing inconclusive symptoms:		
a. Stinging sensation like bee sting.		
b. Tingling sensation.		
c. Swelling & redness.		
d. Numbness of mouth & tongue.		
e. Blurring vision.		
f. Complete muscular paralysis of arms & legs in a few cases.		
g. Healing is rapid & uneventful.		
5. First Aid	List on C.B. or use	
a. Thoroughly cleanse wound.	transparency.	
b. Get medical attention.		
II. Barnacles and Mussels.		
1. Barnacles will grow on almost any under water object.	Show slides.	Take notes.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. Provide a diver with a possible mechanical hazard from cuts & abrasions.		
a. Wet suits afford some protection.		
b. Cleanse barnacle cuts carefully to avoid infection.		
3. Mussels also can cut a diver easily.		
4. At certain times of the year, they can be toxic to eat.		
I. Giant Clams	Show slides.	
1. Usually found in subtropic or tropical waters.		
2. May weigh 200-300 pounds, as much as 700 lbs. reported.		
3. Have been known to trap a diver		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
by closing its halves on a hand or foot.		
4. Victim may be released by severing muscle that holds the halves together.		
J. Barracuda	Show slides.	Take notes.
1. Found in all subtropical & tropical waters.		
2. All barracuda can bite, but the giant barracuda is the most dangerous due to size and ferocity.		
3. The bite is usually a straight line slash type of laceration.		
4. Attracted by anything that enters the water.		
a. Barracuda are extremely curious.		

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b. Bright, shiny objects most likely to be struck- regulators, knives & tanks.

5. Handle barracuda wounds in the same manner as shark bites.

K. Groupers - Sea Bass — Show slides.

1. Present a possible hazard to divers due to their large size - up to 12 ft. weighing 700 lbs.

2. Inhabit tropical & subtropical waters.

3. Bold, very curious and ravenous feeders have caused several fatalities in divers.

4. Handle as for shark bite.

L. Moray Eels.

1. Large vicious eel that can

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
be up to 10 ft long.	Show slides.	Take notes.
2. Extremely powerful jaws inflict a crushing bite that may not be released until killed.		
3. Inhabit tropical & sub-tropical waters, hiding in crevices in coral, caves, & bottom wreckage.		
4. Will attack if provoked.		
5. Treat injuries as you would a shark bite.		
M. Killer Whales.	Show slides.	
1. Large, distinctive and intelligent mammal.		
2. Inhabits all oceans, but prefers colder climates.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
1. A voracious feeder, but there is no recorded instance of human attack.		
4. Known to travel in packs.		
5. If sighted, leave water.		
N. Sea Lions.	Show slides.	Take notes.
1. Large mammals ordinarily found in colder waters.		
2. They are curious, and very fast and agile in the water.		
3. Have been known to snap at swimmers & divers during the mating season.		
4. Avoid contact during breeding season or if young are in the water.		

NAVAL SCHOOL, DIVING AND SALVAGE

SCUBA DIVER A-433-0023

Security Clearance: None
Lesson Topic: 4.1 Visual signals
4.4 Planning
4.11 General Safety Precautions

2 Hours

Instructional Materials:

U.S.Navy Diving Manual, VOL. 1

Student Guides

Standard Classroom equipment

References: NAVSHIPS INST. 9940.16A
NAVSHIPS 0994-009-6010,
Navy Diving Operations Handbook

Open Circuit SCUBA
Semi-closed circuit SCUBA
Closed circuit SCUBA
Film, "Open Circuit SCUBA "
Open, semi-closed and closed circuit
SCUBA principles transparencies
Overhead projector

TERMINAL OBJECTIVES

Partial attainment of the following:

1. When the student completes this course he will be able to demonstrate, without error, all visual signals used while diving open circuit SCUBA.

2. When the student completes this course he will be able to, given a typical fleet SCUBA diving task, illustrate proper planning procedures by outlining steps necessary for a successful completion of the task.

3. When the student completes this course he will be able to demonstrate a knowledge and understanding of safety precautions applicable to the open circuit SCUBA diving training activities.

ENABLING OBJECTIVES:

1. LIST all visual signals used when diving open circuit SCUBA.

2. DEFINE, in writing, all visual signals used when diving open circuit SCUBA.

3. Use appropriate visual signals during diving training activities using open circuit SCUBA.

4. Orally STATE the main advantages/ disadvantages of using open circuit SCUBA.

5. Orally DESCRIBE the application and/or use of open circuit SCUBA diving.

6. DEFINE, orally and in writing, terms used in open circuit SCUBA diving.

ENABLING OBJECTIVES (CONT'D)

7. Orally STATE the most common and second most common diving accidents in the use of open circuit SCUBA.

8. Orally DESCRIBE the minimum number of personnel required when diving open circuit SCUBA.

9. Orally DESCRIBE normal and maximum working depth limitations for open circuit SCUBA.

10. Orally DESCRIBE the reason for using the Buddy System when diving open circuit SCUBA

11. Orally DESCRIBE the safety precautions to be followed when diving open circuit SCUBA:

    a. Dressing the diver.
    b. During the dive.
    c. Decompression.

CRITERION TESTS.

1. Demonstrate, without error, all visual signals used while diving open circuit SCUBA

HOMEWORK

Volume C, Student Guide, Assignment Sheets 4-1-1A and 4-1-2A

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction to the lesson	I A. Introduce self and Topic	
A. Establish contact		
B. Establish readiness	B. Get students ready to learn.	
C. Establish effect.	C. Bring out the need and value of the material being presented	
D. <u>OVERVIEW</u>: When you complete this lesson topic, you will be able to:	D. State learning objectives	
1. Describe three types of SCUBA.		
2. Describe general uses for SCUBA.		
3. List the advantages and disadvantages of SCUBA.		
4. State the 1st and 2nd most common SCUBA casualties.		
5. Describe the minimum number of personnel necessary for diving SCUBA.		
6. Select the proper decompression tables used when diving SCUBA	E. State information necessary to guide the students conduct.	
	1. Questions to clear up misunderstanding.	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
D. OVERVIEW (CONT'D)		
7. Demonstrate visual hand signals used in SCUBA diving.		
8. State reasons for using the Buddy System.		
9. Demonstrate verbal communications procedures while using SCUBA.		
II. Presentation.		
A. Review of principle laws of diving.	Ask for volunteers to explain and give application for SCUBA.	Respond to questions as directed. Take notes as necessary
1. Boyles' Law - The pressure and volume of a gas are inversely related		
a. Application - Free ascent.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. Charles' Law - The amount of change in either volume or pressure is directly related to the change in the absolute temperature. a. Application - Charging of SCUBA cylinders	Ask for volunteers to explain and give application for SCUBA	Respond to questions. Take notes as necessary.
3. Dalton's Law - The total pressure exerted by a mixture of gases is equal to the sum of the pressures of each of the different gases making up the mixture - each gas acting as if it alone was present and occupied the total volume.	Ask for volunteers to explain and give application for SCUBA.	Respond to questions. Take notes as necessary.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
4. Archimedes Principle - any object wholly or partly immersed in a fluid is buoyed up by a force equal to the weight of the fluid displaced by the object.	Ask for volunteers to explain and give application for SCUBA.	Respond to questions. Take notes as necessary.
B. Review of Diving Terminology.	Ask for volunteers to define terminology and, if applicable, its direct relation to SCUBA diving	Respond to questions. Take notes as necessary.
1. Composition of Air a. Nitrogen - 78.084 b. Oxygen - 20.946 c. Carbon dioxide - 0.033 d. Argon (inert)- 0.934 e. Rare gases - 0.003		
2. Pressure - Force per unit area.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

3. Atmospheric pressure - 14.7 PSI weight 1 square inch of sea water 33 ft high
4. Gauge pressur - weight of the water surrounding the diver.
5. Absolute pressure weight of the water surrounding the diver plus the weight of the atmosphere over that water.
6. Partial pressure - The pressure contributed by any gas in the mixture is proportional to the number of molecules of that gas in the total volume.

7. Absolute temperature - The temperature at which all molecular motion would cease.(-459.72°F).

8. Bottom time - Time from when a diver leaves the surface till he leaves the bottom.

9. Decompression time - Total time of surfacing including any stops.

10. Total time - Time from when a diver leaves the surface till he arrives back on the surface.

11. Surface interval - The time which a diver has spent on the surface following a dive Begins as soon as the diver surfaces and ending as soon as he starts his next descent.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

12. Residual Nitrogen Time - The amount of time, in minutes, which must be added to the bottom time of a repetitive dive to compensate for the nitrogen still in solution in divers tissues from a previous dive.

13. Equivalent single dive time. - Residual nitrogen time added to bottom time of repetitive dive.

14. Repetitive dive - any dive conducted within a 12 hour period of a previous dive.

15. Decompression stop - Specified depth at which a diver must remain for a specified length of time

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
to eliminate inert gases from his body.		
C. Self Contained Underwater Breathing Apparatus (SCUBA)	List on C/B	Respond to request by offering advantages for SCUBA.
1. Advantages:	Request students aid in constructing list.	
a. Rapid deployment.		
b. Portability		
c. Minimum support.		
d. Excellent horizontal and vertical mobility.		
e. Minimum bottom disturbance.		
2. Disadvantages.	List on C/B	Respond to instructor's request by offering disadvantages to using SCUBA
a. Limited endurance - depth & duration.	Request student's aid in constructing list.	Take notes as necessary
b. Breathing resistance.		
c. Limited physical protection.		
d. Influence by current 1 knot maximum.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
e. Lack of communications.		
3. Three types of SCUBA - open circuit semi closed circuit closed circuit.	List on C/B	
a. Open Circuit Scuba	Show Vugraph of open circuit SCUBA principles	
(1) Advantages as compared to other SCUBAS.	Explain open circuit principle	
(a) Open Circuit SCUBA is readily available-any SCUBA shop.		
(b) Uses compressed air - <u>ONLY</u>.		
(2) Disadvantages as compared to other SCUBA.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(a) Duration - Because of the open circuit principle.		
(3) Restrictions.	CARDINAL RULE	
(a) Depth.	NEVER MAKE A DECOMPRESSION	
(1) Working- 60 Ft for 60 min.	DIVE IN SCUBA.	
(2) Maximum - 130 Ft for 10 Min.		
(3) EMERGENCY - The total time and Depth of a SCUBA dive (including decompression).		

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must never exceed the duration of the apparatus in use. Disregarding any reserves.

(b) Current-
1 knot max.

(c) Diving Team
Min. 4 men.
(1) Supervisor
(2) Diver
(3) Tender/ Timekeeper
(4) Standby Diver.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
b. Semi-closed Circuit SCUBA (MK VI)	Show vugraph of semi-closed circuit principles	
(1) General description of semi-closed circuit principal	EXPLAIN - Semi-closed circuit principles	
(2) Advantages as compared to other SCUBA.		
(a) Effective utilization of mixed gas supply.		
(b) Reduced surface bubbles.		
(3) Disadvantages as compared to other SCUBA.		
(a) Uses only HeO2 or N2O2 mixtures hard to obtain or mix.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

4. Restrictions.

a. Work limits - HeO2

(1) Normal-130'/35 min

(2) Max - 200'/30 min.

b. Work limits - N_2O_2

(1) Normal-130'/30 min.

(2) Max - 170'/30 min.

c. Current - 1 knot max.

d. Diving team.

(1) 1 Diver - Minimum

4 men.

(2) 2 Divers - min.

6 men

(3) EOD/UDT/SEAL

Min. 4 men

D. Closed Circuit SCUBA (O_2 Emerson) — Show vugraph of closed circuit SCUBA principal.

1. General description

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
of closed circuit principle	Explain closed circuit SCUBA principle	
2. Advantage as compared to other SCUBA.		
a. No surface bubbles.		
b. Long duration due to closed circuit principle.		
3. Disadvantages as compared to other SCUBA.		
a. Limited to shallow depths.		
b. O_2 toxicity hazard.		
4. Restrictions		
a. Work limits.		
(1) Normal 25'/75 min		
(2) Max -40'/10 min		
b. Current-1 knot max.		
c. Diving team.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(1) 1 Diver-Min.4 Men		
(2) 2 Divers-Min 6 Men		
(3) EOD/UDT/SEAL - Min. 4 men		
E. General Uses of SCUBA		
1. Inspections; hull, dry-docks, piers, etc.		
2. Searches - hull, ocean or harbor bottom.		
3. Light underwater work - patching, removing screws, unfouling cables, etc.		
4. Clandestine Operation - attacks, infiltration		
F. Most common cause of SCUBA casualties.	List on C/B	
1. Drowning	Explain over breathing	
a. Exertion		
b. Overbreathing		
c. Panic		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
G. Minimum number of personnel necessary for diving SCUBA 1. Diving supervisor 2. Diver 3. Standby diver 4. Attendant/timekeeper	List on C/B	
H. Buddy System 1. Eye or line contact with buddy. 2. If a single diver is used he should be tended by a surface line. 3. A surface line should also be used when diving as buddy's if conditions seem particularly hazardous.	Explain Buddy System thoroughly! Emphasize importance of using Buddy System AT ALL TIMES.	

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Select proper decompression tables.		
1. SCUBA dives involving decompression are dangerous.	DANGEROUS	
2. SCUBA dives involving decompression should never be made except as a last resort.	STRESS SAFETY. EMPHASIZE	
3. The total time and depth of a SCUBA dive (including decompression) must never exceed the duration of the apparatus in use disregarding any reserves.		
J. Visual hand signals	Call on students to show signals	Demonstrate hand signals when asked
1. Numbers 0 - 9		
2. Hold everything		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
3. All right.		
4. Pick me up.		
5. Emergency		
6. Lets go up.		
7. What time.		
8. Ear trouble.		
9. Air trouble.		
10. What direction		
11. How deep.		
12. All signals should be in a forceful and exaggerated manner so that there can be no ambiguity.		
13. EVERY SIGNAL MUST BE ACKNOWLEDGED.		
III. Recap of lesson	III. Recap of lesson ask questions of students from todays lesson	
A. Advantages of SCUBA		
B. Disadvantages.		
C. Types of SCUBA		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
D. Advantages and disadvantages of open circuit SCUBA.		
E. Restrictions for open circuit SCUBA.		
F. General uses of SCUBA.		
G. Buddy System.		
IV. Movie Preview - Open Circuit SCUBA	IV. Preview Movie	
A. Observe the following:		
1. Advantages and disadvantages.		
2. Uses of SCUBA.		
3. 3 types of SCUBA.		
4. SCUBA accessories.		
5. Brief explaination of cylinders and regulators.		
6. Dressing of diver - mistake of placing weight belt on first.	Point out mistakes	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
7. Buddy system and number of divers required.	Mistake (4 divers vice 3)	
8. Safety precautions.		
9. Pre-dive checks.		
10. Method of swimming.		
11. Mask clearing.		
12. Emergency ascent.	Mistake - not holding hands above head when arriving on the surface. STRESS EXHALATION.	

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SCUBA DIVER A-431-0021

SECURITY CLEARANCE: NONE

LESSON TOPIC 4.2 SCUBA INSPECTION AND MAINTENANCE PROCEDURES

14 Hours

INSTRUCTIONAL MATERIALS

U.S. NAVY DIVING MANUAL, Vol. I
Student Guides
NAVSHIPS 0994-008-0100
NAVSHIPS 394-0065
NAVSHIPS Inst. 9940.16A
Standard Classroom Equipment
Open Circuit SCUBA:

Face mask
Swim fins
Life vest (PK III, CDT)
Flare (PK 13, Mod 0)
Strobe light
Diver"s light
Knife
Wet suit
Cylinders
Double Hose regulator
Single Hose regulator
Buoy and buoyline
Weight belt
HP Guage
Compass
Depth Guage
Buddy Line
Watch
Snorkel

Special Tools for Regulator Repair.

TERMINAL OBJECTIVE.

1. When the student completes this course he will be able to demonstrate proper inspection and maintenance procedures (in accordance with Planned Maintenance System requirements) for the following open circuit SCUBA equipment and related underwater accessories: Open circuit SCUBA cylinder and manifold assembly, Single Hose Regulator System, Double Hose Regulator System, Life Jacket, DiverLight, and Wet Suit.

ENABLING OBJECTIVES:

1. Orally explain the function(s) of each component and the component parts for each piece of equipment and underwater accessory.

2. Given a standard print of each component, show the physical location of each component and component part.

3. List, in writing, the major materials used, EXPLAINING why, for each component and selected component parts.

4. List, orally, the protective device(s) found on the open circuit SCUBA cylinder and manifold assembly, single and double hose regulator, and

ENABLING OBJECTIVES (CONT'D)

life jacket and DESCRIBE the protective provided by each.

5. Orally LIST the position(s) and function(s) of each position for the Air Reserve Assembly and block/shut off valve of the cylinder and manifold assembly system.

6. Orally DESCRIBE the nominal pipe or valve size for the elbow assembly and block/shut off valve.

7. Given a standard print of the components, DESCRIBE, orally, the flow path of the breathing media through the cylinder and manifold assembly and single/double hose regulator systems.

8. For cylinder operating pressure, reserve air supply, safety disks and plugs, and over bottom pressure, STATE, orally, the major parameters and reasons for them, in terms of effect(s) of operating above/below them.

9. Orally DESCRIBE the interrelation of the systems.

10. Orally DESCRIBE inspection/maintenance procedures for each component part within each peice of equipment.

11. PERFORM, under instructor guidance, inspection/maintenance (in accordance with Planned Maintenance System requirements) on the equipment listed in the Terminal Objective so that it may be used in open circuit SCUBA Diving training activities.

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CRITERION TEST

1. Demonstrate proper inspection and maintenance procedures (in accordance with Planned Maintenance System requirements) for the following open circuit SCUBA equipment and related underwater accessories: Open circuit SCUBA cylinder and manifold assembly, Single hose regulator system, Double hose regulator system, Life Jacket, Divers light, and wet suit.

HOMEWORK

Volume C, Student Guide:

Diving Accessories - Information Sheet 4-2-1I, wrist depth gage instruction, Assignment sheets 4-2-1A, 4-2-2A, 4-2-3A, 4-2-4A, 4-2-5A and 4-2-6A.

Cylinder and manifold assembly- NAVSHIPS TECH Manual 0994-008-0100, Assignment sheets 4-2-7A and 4-2-8A.

Double Hose Regulator - Assignment Sheet 4-2-9A.

Single Hose Regulator - Assignment Sheets 4-2-10A and 4-2-11A.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
1. Introduction to the lesson:		
A. Establish Contact.	Introduce self and topic.	
B. Establish Readiness.	Get students ready to learn.	
	1. Motivate.	
C. Establish Effect.	Bring out the need and value of the material being presented.	
D. OVERVIEW: Upon completion of this lesson you will be able to describe the following SCUBA accessories.	State Learning objectives.	
1. Mask		
2. Fins		
3. UDT and MK III life vest		
4. Weight Belt		
5. Knife- Cres/K-Bar		
6. HP Guage		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
7. MK 13 MOD 0 Flare		
8. Compass		
9. Depth Gauge		
10. Wet Suit		
11. Buddy Line		
12. Light		
13. Bouy		
14. Watch		
15. Strobe Light		
16. Snorkel		
	State information necessary to guide the students conduct. 1. Questions 2. Pay close attention as you will be wearing this equipment.	

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. Presentation:		
A. Protective and Safety Accessories used in open circuit SCUBA diving. Must be Navy Approved (NAVSHIPS 9940.16A).		
1. Wet Suit (Hood, booties, mitts).	Show actual object and discuss, or use slide/ transparency presentation.	Listen, observe closely and take notes as necessary.
a. Closed cell neoprene 1/8-1/2".		
b. Protects diver from cold water, long exposure in moderate temperatures, chemical and bacterial pollution, hazards of marine life and underater obstacles.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
c. Should be proper fit. Not too loose or tight as to restrict movement or be uncomfortable.	Demonstrate.	
d. Principle: allows a thin layer of water to come between the wet suit and skin and is warmed by body heat.	Show on C.B.	
e. Should rinse suit in fresh water after use.		
f. Hints:		
1. Remove suit carefully.	Demonstrate.	
2. Weakest points are around zippers.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
3. Should apply silicone to zippers on a regular basis.		
2. Life Vest: Mandatory item .	Show object and discuss or use slide/transparency presentation.	Observe, listen and take notes as necessary.
a. Modified UDT life preserver.		
1. 18 gram CO_2 cartridge.		
2. Oral inflation tube.		
3. Automatic inflation device		
4. 19 lbs. positive bouyancy at 18 ft.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
5. Not effective over 36 ft.		
6. Main function is to keep head upright in a floating position.		
7. The only item of open circuit SCUBA <u>not</u> secured with a quick release.	Emphasize. Demonstrate.	
b. MK III Yoke Type	Show object and discuss <u>or</u> use slide/transparency presentation.	Observe, listen and take notes as necessary.
1. 4 31 gram CO_2 cartridges.		
2. 2 oral inflation tubes.		
3. 2 automatic inflation devices.		
a. one for each chamber.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
4. 19 lbs positive bouyancy at 200 ft.		
5. 55 lbs positive bouyancy on surface.		
6. If 18 gram CO_2 cartridge accidentally used, vest has 12 lbs positive bouyancy at 200 ft.		
7. No quick release.	Emphasize.	
3. Knife.		
a. Should be corrosion resistent metal (stainless).	Show object and discuss or use slide/transparency presentation.	Observe, listen and notes as necessary.
b. Should have plastic, hard rubber or wood handle.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
c. May be single or double edged. Prefer double edge with knife blade and saw-tooth.		
d. Scabbard should hold the knife with a positive but easily released lock.		
e. May be worn on: UDT life vest, hip, leg, wet suit. Never on the weight belt.		
4. Mark 13 Mod Flare (Day /Night):	Show object and discuss use slide/ transparency presentation.	Observe, listen and take notes as necessary.
a. Used only in case of emergency.		
b. Smooth end (day) emitts		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
90 secs. of red-orange smoke.		
c. Ring of raised beads (night) emitts 90 secs. of brilliant red light.		
d. Never carry the flare by the pull ring.		
1. Tape to knife.		
2. Burn hazard.	Emphasize.	
3. Hold away from body.		
5. Strobe Light.		
a. Emitts a bright flash approx. once each second.	Show object and discuss.	Observe, listen and take notes as necessary.
b. Emergency use only.		
c. Rubber covered push switch.	Demonstrate.	

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
6. Compass a. Used for underwater navigation. b. May be worn on the wrist or swim board. c. Some models are radiation hazards. d. Use a good band to prevent loss.	Show object and discuss or use slide/transparency presentation. Emphasize.	Observe, listen and take notes as necessary.
7. Depth Guages. a. Used to determine depth of dive. b. Must be accurate within 1 ft. at 50 ft and 3 ft from 50-300 ft. c. Must be checked for	Show object and discuss or use slide/transparency presentation.	Observe, listen and take notes as necessary.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
accuracy every 6 months or when malfunction is suspected.		
1. Should be checked before use on a dive if new.		
d. Phosphorus dial for easy reading in limited visibility.		
1. radiation hazard.	Emphasize.	
8. Watch	Show object and discuss or use slide/transparency presentation.	Observe, listen and take notes as necessary.
a. Phosphorus dial for easy reading in limited visibility.		
b. Rotating bezel for indication elasped time of dive.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
c. Watch and depth guage should be worn on the same arm as they are closely related.		
9. Diving Light a. Used to illuminate divers way or job. b. Must be waterproof and depth tested.	Show object and discuss or use slide/transparency presentation.	Observe, listen and take notes as necessary.
10. Face Mask a. Primary purpose is to protect diver's eyes & and nose from water. b. Secondary purpose	Show object and discuss or use slide/transparency presentation.	Observe, listen and take notes as necessary.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
is to provide maximum visibility. c. Lens must be of tempered or shatterproof safety glass. d. Insure proper fit, hold mask to face, inhale gently and remove hand. Mask should remain in place. e. Adjustable straps used to secure mask.	Demonstrate	
11. Swim Fins. a. Increase the efficiency of the diver. b. Various degrees of	Show object and discuss or use slide/transparency presentation.	Observe, listen and take notes as necessary.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
of flexability & design of blade. c. 2 basic types of blade. 1. Straight 2. Offset d. Fixed strap, adjustable strap & shoe socket. e. Normally wear foot gear (booties) to prevent irratation and blisters.	Draw on C.B. or show.	
12. Snorkel a. Breathing tube which allows diver to swim face down in the water. Less tiring.	Show object and discuss or use slide/transparency presentation.	Observe, listen and take notes as necessary.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
B. Useful for searching in shallow depths. (Conserve SCUBA). c. Variety of Models.		
13. Weightbelt a. Used to overcome the positive bouancy of most divers and the bouyancy of a wet suit. b. Must have a quick release buckle operable by either hand. c. Made of rot and mildew resistent fabric (nylon webbing).	Show object and discuss or use slide/transparency presentation.	Observe, listen and take notes as necessary.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
d. Weights should have smooth edges so as to not irrate divers skin or damage protective gear.		
e. Weights come in various sizes and designs to suit each individual diver.		
f. Take time to properly adjust weightbelt(for near neutral bouyancy).		
g. Weight belt most often lost during water exit/ entry.		
14. Bouy and bouyline	Show object and discuss or use slide/ transparency presentation.	Observe, listen and take notes as necessary.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
a. Used in poor visibility or when safety of diver is in question. b. Never attach to a piece of equipment which may be ditched. c. May be of any floatable material; painted wood, sealed bottle, life ring or inner tube.		
15. Buddy Line a. 6 to 10 ft long. b. A must at night or in conditions of poor visibility. c. Any line used in SCUBA operations	Show object and discuss or use slide/transparency presentation.	Observe, listen and take notes as necessary.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
should be strong and have neutral or slightly negative bouyancy. Nylon, dacron, and manila are suitable.		
16. High Pressure Guage a. 0-3000 psi. b. Has yoke fitting to attach to cylinder manifold. c. Has a relief valve to bleed off the pressure after securing cylinder value. d. Should be calibrated or compared with other	Show object and discuss or use slide/transparency presentation.	Observe, listen and take notes as necessary.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
known-accurate guages periodically.		
17. Questions on accessories.	Answer questions as necessary.	Ask/answer questions as necessary.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction to the lesson		
A. Establish contact	Introduce self & topic	
B. Establish readiness	Get students ready to learn	
1. Personal experience		
C. Establish effect	Bring out the need and value of the material being presented.	
D. Overview:	State learning objectives	
Upon completion of this lesson you will be able to demonstrate proper inspection and maintenance procedures (in accordance with planned maintenance system requirements) for the Open Circuit SCUBA Cylinder and manifold assembly System	State information necessary to guide the students conduct during the lesson. a. Notes b. Questions c. Information needed	

ENABLING OBJECTIVES:

1. Orally explain the function(s) of the major components and component parts for the cylinder and manifold assembly system.

2. Given a standard print of the cylinder and manifold assembly system, show the physical location of each component and component part.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
ENABLING OBJECTIVES (CONT'D)		ENABLING OBJECTIVES (CONT'D)
3. List, in writing, the major materials used, explaining why, for each component and selected component parts.		9. Orally describe inspection/maintenance procedures for each component part within the cylinder and manifold assembly.
4. List, orally, the protective device(s) found on the cylinder and manifold assembly system and describe the protection provided by each.		10. Perform, under instructor guidance, inspection/maintenance (in accordance with planned maintenance system requirements) on the cylinder and manifold assembly so that it may be used in Open Circuit SCUBA Diving training activities.
5. Orally list the position(s) and function of each position for the Air Reserve Assembly and block/shut off valve of the cylinder and manifold assembly systems.		
6. Orally describe the nominal pipe or valve size for the elbow assembly and block/shut off valve.		
7. Given a standard print of the cylinder and manifold assembly, describe, orally, the flow path of the breathing media through the system.		
8. For cylinder operating pressure, reserve air supply, safety disks and plugs, and over bottom pressure, state orally, the major parameters and reasons for them, in terms of the effects of operating above/below them.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
II. Presentation.		
A. Cylinders - Steel, High Pressure.	List on C/B or use slide presentation	Observe & take notes as necessary.
1. Filled with compressed air.		
a. Never fill with oxygen.		
b. Explosion, diver poisoning.		
2. One or more used.		
3. Working pressure - 2250 PSI		
4. Approximate volume: 72 cu ft at 2250 PSI		
5. Under D.O.T. Regulations (formerly I.C.C.)		
a. Must be hydrostatically tested every 5 yrs.		
b. Tested to 3750 PSI - 1 2/3 times the working pressure.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
B. Cylinders, aluminum, high pressure		Observe & take notes as necessary.
1. Filled with compressed air		
a. Never fill with oxygen		
b. Explosion, diver poisoning.		
2. One or more used.		
3. Working pressure - 3000 PSI		
4. Approximate volume - 90 cu ft at 3000 PSI		
5. Under NAVSHIPS control		
a. Must be hydrostatically tested every 3 years.		
b. Tested to 5000 PSI - 1 2/3 times working pressure.		
6. Information stamped on cylinder:		
a. Test pressure		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

6. Information stamped on bottle neck.
   a. Working pressure.
   b. Serial number
   c. Month/year of most recent hydrostatic test.
   d. Hydro facility symbol.
7. All cylinders under the planned maintenance system (PMS).
   a. Annual requirements in use or stored.
      (1) Bottles broken down and internally inspected.
      (2) Repair as necessary.
   b. Bottles in use - inspect weekly.
      (1) Maintain at 1500 PSI minimum.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
b. Working pressure. c. Serial number. d. Hydrostatic test date e. Rockwell hardness test. f. Actual measured wall thickness. g. Minimum wall thickness permitted. 7. Cylinders in use - inspect weekly. a. Maintain 1500 PSI min.		
C. Test/Inspection of Cylinders 1. All cylinders (in use or storage) broken down and inspected every 12 months. 2. If water or particulate matter is suspected to have entered cylinder, it must be inspected before subsequent use.	Demonstrate using cutaway or actual cylinder	Observe and take notes as necessary.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

3. Inspection, cleaning, and testing procedures - NAVSHIPS INST 9940.16
4. Safety Regulations H.P. Gas Cylinders.
   a. NAVSHIP TECH, MAN 9230
   b. SCUBA Cylinders - Table 5-2, Diving Manual
5. Inspection will be a scheduled, systematic evolution:
   a. Bleed down bottle.
   b. Remove manifold.
   c. Inspect visually.
      (1) Aided by inspection light.
   d. Look for:
      (1) Corrosion.
      (2) Pits - Requires Hydro. 1298

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(3) Visible accumulation - jelly-like substance.		
(4) Inspect threads and O-ring seating surface.		
6. Cleaning Procedure.	Demonstrate or explain thoroughly.	
a. Place wash banked gravel and water in cylinder.		
(1) 4 qts gravel and 2 qts water in steel cylinder.		
(2) 5 qts gravel and 2 1/2 qts water in aluminum cylinder.		
b. Roll cylinder about its axis.		
(1) Until interior is clean.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(2) Do not try to remove pits or protrusions.		
(a) If pits are present, hydro cylinder.		
(3) If cylinder won't clean up, destroy it.		
c. Once clean.		
(1) Empty and wash out thoroughly.		
(a) Use a mild detergent and warm water.		
(2) Rinse with warm fresh water.		
(3) Dry with clean compressed air.		
7. Hydrostatic Test.		
a. Test facilities	1210	Observe and take notes as necessary.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

(1) Commercial firm - qualified to perform D.O.T. tests.

(2) Authorized Naval Commands.

b. Test is water jacket method.

(1) Measures expansion characteristics.

c. All failures must be physically destroyed.

8. Replacement of cylinders.

a. Comprehensive test records must be kept.

b. Previous test history and costs are important factors in determining cylinder replacement.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
D. Manifold-High Pressure	Show equipment	Observe and take notes as necessary
1. Passes air from cylinder to regulator.		
2. Consists of following:		
a. Cylinder valve - on/off valve.		
b. High pressure blow-out plugs/disks.		
(1) One (1) on single manifold.		
(2) Two (2) on twin manifold.		
(3) Two types.		
(a) Actual lead filled plug.		
1. One piece design		
2. Rating stamped on the head.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(b) Safety disk, plug assembly. 1. Two piece design safety disk and safety plug. 2. Safety disks color coded. a. 2250 tank - BLACK - blows at 3400 PSI. b. 3000 tank - RED - blows at 3900 PSI.		
(c) Never use incorrect plugs or disks.	IMPORTANT-EMPHASIZE	
(d) Destroy uncoded disks.		
(e) PLUGS ALWAYS POINT AWAY FROM DIVER.	IMPORTANT. DEMONSTRATE	

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
c. Reserve Valve Mechanism.		
(1) Gives warning of low air supply.		
(2) Provides diver with air to surface safety.		
(3) Holds back 300-500 PSI.		
(a) Twin cylinders - left bottle only.		
(b) Spring loaded check valve.		
(c) Manual override.		
(4) As air pressure in tank decreases.		
(a) Valve slowly closes.		
(b) Causes regulator to breathe hard.		
(c) Diver pulls down reserve lever.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(d) valve opens - supplying remaining 300-500 psi air.		
(5) Never assume reserve will work.	IMPORTANT. EMPHASIZE.	
(a) Could be damaged during the working dive.		
(b) Could be accidently accuated earlier.		
(6) Divers, in pairs, must surface immediately, if either goes on reserve air.	IMPORTANT. EMPHASIZE	
(7) Reserve valve must be down for:	DEMONSTRATE	
(a) Charging.		
(b) Gauging.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(c) If left up during charging, only right cylinder will fill with air.		
d. Trace air flow cylinder to regulator.	Demonstrate using equipment, chart, C/B or slide	Observe and take notes as necessary
(1) Right cylinder to regulator.		
(a) Air exits bottle via elbow assembly.		
(b) Passes by safety blow-out plug.		
(c) From elbow into center yoke.		
(d) Passes up to nipple disk assembly of cylinder valve.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(e) Air flow is controlled by cylinder valve.		
(2) Left cylinder via reserve assembly.	Demonstrate using equipment, chart, C/B or slide.	Observe and take notes as necessary.
(a) Air exits cylinder via elbow assembly.		
(b) If 500 PSI or more, it unseats disk of reserve assembly.		
(c) Flows by unseated disk, and safety blow-out plugs.		
(d) Flows through the channel housing 500 PSI reserve spring.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(e) Through insert - holds 500 PSI in place.		
(f) Exits reserve valve assembly.		
(g) Enters center yoke.		
(h) Continues to seat & disk assembly of on/off valve.		
(i) Air flow is controlled by cylinder valve.		
(3) Manual override, reserve assembly.	DEMONSTRATE using equipment, chart, C/B or slide.	
(a) At 300-500 PSI, spring pushes disk closed.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(b) To physically override disk, push reserve handle down. (c) Reserve stem rotates 180°. (d) Pin& Plunger assembly has two grooves. 1. Shallow 2. Deep (e) Reserve stem is in deep groove - reserve up. 1. This allows spring to hold pin & plunger assembly away from disk.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
a. 500 psi spring controlls disk and air flow.		
(f) 180° rotation - reserve down.	DEMONSTRATE	
1. Reserve stem in shallow groove.		
2. Pin & plunger assembly is physically holding disk open - allowing air flow.		
3. Diver is on reserve air.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
E. Repair of Manifold.		
1. <u>Never</u> attempt repairs on a charged bottle.	IMPORTANT - EMPHASIZE.	
2. Bleed down before starting any repairs.		
3. Use Tech Manual and correct diagrams.	IMPORTANT.	
a. Do not attempt repairs by memory.		
4. Maintain a clean - organized work area.		
5. <u>DO NOT</u> use oil or grease for lubrication.	IMPORTANT- EMPHASIZE	
a. Dow corning	Oxygen and breathing	
b. Flora Lub	air system approved	
6. Use correct and clean tools.		
7. Use correct replacement parts.		
8. Always test after any repair is made.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
9. Take your time. - do it right.		
a. Consider the consequences of a malfunction on the bottom.		
QUESTIONS	Answer any quest.ons	Ask questions as they occur to you.
Time permitting, have students trace air through the cylinder/manifold assembly - orally.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction to the Lesson	Introduce self and topic	
A. Establish Contact	Get students ready to learn	
B. Establish Readiness		
1. Personal experience		
C. Establish Effect	Bring out need and value of the material being presented.	
D. OVERVIEW	STATE LEARNING OBJECTIVES	
Upon completion of this Lesson Topic you will be able to demonstrate proper inspection and maintenance procedures (in accordance with planned maintenance system requirements) for the open circuit SCUBA double hose regulator.	STATE INFORMATION NECESSARY TO GUIDE THE STUDENTS CONDUCT DURING THE LESSON. a. NOTES b. Questions c. Information needed	

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

ENABLING OBJECTIVES

1. Orally explain the function(s) of each component and the component parts of the open circuit SCUBA double hose regulator.
2. Given a standard print of the open circuit SCUBA double hose regulator, show the physical location of each component and component part.
3. List, in writing, the major materials used, explaining why, for each component and selected component parts of the open circuit SCUBA double hose regulator.
4. List, orally, the protective device(s) found on the open circuit SCUBA double hose, regulator and describe the protection provided by each.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

5. Given a standard print of open circuit SCUBA components, describe orally, the flow path of the breathing media through the cylinder and manifold assembly and double hose regulator.
6. Orally describe the interrelation of the systems.
7. Orally describe inspection/maintenance procedures for each component part within the open circuit SCUBA double hose regulator.
8. Perform, under instructor guidance, inspection/maintenance (in accordance with Planned Maintenance System requirements) on the open circuit SCUBA double hose regulator so that it may be used in open circuit SCUBA

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
diving training activities.		
PRESENTATION		
A. Principles of Double Hose Regulators.		
1. Reduces high pressure air to a pressure usable by diver at depth.	USE chart, slide, or chalkboard to illustrate	Observe and take notes as necessary.
2. Two stage reduction		
a. High pressure or first stage - reducing valve		
(1) Reduces H.P. Air to a constant 110(+/-5) psi over bottom pressure.		
b. Low pressure or second stage - reducing valve		
(1) Reduces 110 psi over bottom to exactly ambient water pressure at		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
operating depth. (2) Upon demand, delivers air to divers lungs. (a) Diver inhales-creating a pressure imbalance (b) Pressure imbalance between divers lungs and ambient water pressure, forces diaphragm to move. (c) This opens low pressure flow valve allowing air to flow to diver.		
B. Principle Parts 1. Regulator a. 1st and 2nd stage located inside regulator box. 2. Inhalation Hose	Use chart, slide or actual equipment to show location.	Observe and take notes as necessary.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
a. Hose on right side.		
3. Mouthpiece		
a. Relatively watertight channel into divers mouth.		
b. Contains two check valves.		
(1) right side		
(a) allows air into mouthpiece	Use chart, slide or actual equipment to demonstrate	Observe and take notes as necessary.
(b) prevents air from entering into inhalation hose.		
(c) opens on inhalation		
(d) closes on exhalation		
(2) Left side		
(a) hose on left side		
(b) channels exhausted air back to regulator and out		
1. has flapper valve in		

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regulator box/end
of hose prevents water
from entering hose

C. Air Flow-Double Hose Regulator

1. H.P. Air to Intermediate Pressure

a. Enters sintered filter

b. Passes by:

(1) spring block (11)

(2) High pressure seat, spring (12)

(3) High pressure seat assembly (13)

(4) Pin and Pin support (15 & 16)

c. Air is now in intermediate pressure chamber.

d. Pressure reaches 110 psi

(1) depresses diaphragm

(2) diaphragm depresses diaphragm spring.

(3) allows H.P. seat spring to close

H.P. seat assembly

(4) Remains closed until intermediate pressures drops below 120 psi

e. Pressure drops below 110 psi

(1) Diaphragm can no longer hold diaphragm spring

(2) Spring expands, moving pin and pin support linkage.

(3) Overrides H.P. seat spring, opening H.P. seat.

(4) Allows H.P. air to flow into intermediate chamber until 110 psi is reached.

(5) 110 psi diaphragm and spring are depressed.

(6) H.P. seat spring closes H.P. seat assembly.

(1) L.P. seat assembly

(2) L.P. seat spring

(3) Horse shoe lever

(4) L.P. Diaphragm

d. Diver inhales

(1) Pulls partial vacuum in L.P. chamber.

(2) L.P. diaphragm collapses toward pressure decrease

(3) Pushes horseshoe lever

(4) Accuates L.P. seat assembly

(5) L.P. valve opens, air refills L.P. chamber.

(6) Diaphragm returns to normal position.

(7) L.P. seat spring closes L.P. valve.

D. Advantages and Disadvantages of Double Hose Regulators.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

f. Overbottom Pressure

(1) Controlled by diaphragm spring and adjustment screw

(2) by means of an adjustment screw (18)

(3) Spring tension is set

(4) Designed to work at 110 psi (+ or -5)

(5) Attach a guage to intermediate chamber

(6) Turning adjustment screw sets overbottom pressure.

2. Intermediate Pressure to Breathable Air

a. Air exits intermediate pressure chamber via L.P. valve assembly.

b. Breathable air is now in chamber.

c. L.P. Valve assembly

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

1. Advantages
   a. Resistent to freeze up
   b. Air in inhalation hose is at a pressure equal to surrounding water pressure.
      (1) Should a rupture occur, slow leak instead of rapidly depleted air supply.
   c. Bubbles exhausted behind diver doesn't affect visibility.
2. Disadvantages
   a. Placing second stage below diver causes free flow
      (1) effects working on your back
   b. Two hoses offer increased water resistence
   c. Warm weather causes soft goods (flapper, check valves) to stick together.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
d. Hygene problems with mouthpiece and hoses.		
E. Repair of Double Hose Regulator		
1. Disassemble and repair malfunctioning regulator		
a. Use proper tech manual		
(1) NAVSHIPS 394-0065		
(2) U.S. Diver Regulator Repair Manual		
b. Use of tools	DEMONSTRATE	
(1) H.P. Block assembly guide		
(2) Overbottom pressure test guage		
(3) body spanner wrench		
(4) body wrench/vise		
(5) circlip pliers		
c. Disassemble		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. General Procedures a. insure all pressure is bled down. b. clean organized work area c. proper tech manual d. proper tools e. Replace all fiber washers, gaskets and O-rings (1) Do not reuse old soft goods f. use correct replacement parts only. g. use approved lubricants h. take your time.	Using tech manual, explain each step of disassembling, inspection and reassembling	OBSERVE-Question as necessary

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVIT
I. Introduction to the Lesson	Introduce self and topic	
A. Establish Contact		
B. Establish Readiness	Get students ready to learn	
1. Personal Experience		
C. Establish Effect	Bring out the need and value of the material being presented.	
D. Overview	State learning objectives	
Upon completion of this lesson topic you will be able to demonstrate proper inspection and maintenance procedures (in accordance with Planned Maintenance System Requirements) for the open circuit SCUBA Single Hose Regulator.	State information necessary to guide the students conduct during the lesson. a. Notes b. Questions c. Information needed.	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

ENABLING OBJECTIVES

1. Orally explain the function(s) of each component and the component parts of the open circuit SCUBA single hose regulator.
2. Given a standard print of the open circuit SCUBA single hose regulator, show the physical location of each component and component part.
3. List, in writing, the major materials used, explaining why, for each component and selected component parts of the open circuit SCUBA single hose regulator.
4. List, orally, the protective device(s) found on the open circuit SCUBA single hose regulator and describe the protection provided by each.
5. Given a standard print of open circuit

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
SCUBA components, describe, orally, the flow path of the breathing media through the cylinders and manifold assembly and single hose regulator.		
6. Orally describe the interrelation of the systems.		
7. Orally describe inspection/maintenance procedures for each component part within the open circuit SCUBA single hose regulator.		
8. Perform, under instructor guidance, inspection/maintenance procedures (in accordance with Planned Maintenance System requirements) on the open circuit SCUBA single hose regulator so that it may be used in open circuit SCUBA diving training activities.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
II. PRESENTATION		
A. Principles of Single Hose Regulators		
1. Reduces high pressure air to pressure usable by diver at depth.		
2. Two stage reducer	Use chart, slides, or actual equipment to show location of components	Observe and take notes as necessary
a. First Stage - Reducing Valve		
(1) Reduces H.P. air to constant 125 (+/-5) psi overbottom pressure.		
b. Second Stage - Reducing Valve		
(1) Reduces 125 psi overbottom to exactly ambient water pressure at operating depth.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(2) Upon demand, delivers air to divers lungs. (a) diver inhales- produces pressure imbalance between divers lungs and ambient water pressure. (b) imbalance acts on diaphragm, opening L.P. flow valve (c) allows air to flow to diver		
B. Principle Parts 1. 1st Stage (High pressure) a. separate unit b. fastens to manifold by yoke 2. Intermediate Pressure Hose	Show Parts	Observe and take notes as necessary

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a. delivers 125 psi
air between stages
b. male end and o-ring
to 1st stage
c. female end and o-ring
to 2nd stage.

3. 2nd Stage (low pressure)
- Box contains:
a. Low Pressure reducing
mechanism
(1) L.P. flow valve
(2) lever
(3) diaphragm
b. Rubber mouthpiece
(1) snaps for holiday
band (throw away)
c. Exhaust valve - allows
air out, keeps water out
(1) built into bottom of

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2nd stage box (2) Exhaust tube or channel d. Purge button (1) Located on top of L.P. box (2) Mechanically over-rides L.P. Stage (3) Physically depressed (a) causes L.P. flow valve to deliver air. (4) Quickly clears regulator.		
C. Air Flow - Single Hose Regulator 1. H.P. Air to intermediate pressure a. H.P. air enters via sintered filter	Use chart, slide, or actual equipment to demonstrate.	Observe and take notes as necessary

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b. Passes by or through:

(1) H.P. Block Assembly

(a) spring (16)

(b) block (18)

(c) O-ring (17)

(2) H.P. Seat Assembly Spring (19)

(3) H.P. Seat Assembly (if open)

(4) Pin and support (7&8)

c. Air now at intermediate pressure (125 psi)

(1) H.P. Diaphragm depresses

(2) Diaphragm spring (2)- preadjusted to 125 psi tension

(3) This allows H.P. seat assembly spring to close

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H.P. seat assembly.

d. Pressure drops below 125 psi.

(1) 125 psi spring expands, moving pin and pin support linkage.

(2) Overrides H.P. seat assembly open.

(3) Pushes H.P. seat assembly open.

(4) Air enters IM chamber/ hose until 125 psi.

(5) 125 psi diaphragm and spring are depressed.

(6) H.P. seat assembly is closed by HP. seat as-

sembly spring.

e. Overbottom Pressure.

(1) Controlled by diaphragm spring and adjustment spring.

(2) By adjustment screw.

(3) Tension set at 125 psi.

(4) Regulator designed to work at 125 psi.

(5) Attach guage to intermediate port or hose-turn adjustment screw to set overbottom pressure.

2. Intermediate Pressure to Breathable Air.

a. Air exits intermediate pressure hose via L.P. valve assembly.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(1) Located in L.P. stage box.	Use chart, slide or actual equipment to demonstrate.	Observe and take notes as necessary.
b. Breathable air now in L.P. chamber.		
c. L.P. valve Assembly (flow valve).		
(1) inlet nipple - contains L.P. seat (16).		
(2) L.P. disc (22) and disc retainer assembly (23).		
a. washer		
b. lever		
c. spacer		
d. lock nut		
(3) L.P. disc spring.		

(4) L.P. diaphragm.

d. Diver inhales.

(1) pulls partial vacuum in L.P. chamber.

(2) L.P. diaphragm collapses toward pressure decrease.

(3) Movement pushes lever on disc retainer assembly.

(4) Disc retainer assembly lifts L.P. disc from seat.

(5) L.P. flow valve is open-air flows to diver.

(6) Diver stops inhaling or exhales.

a. diaphragm returns to normal position.

b. L.P. disc spring closes L.P. disc on to seat.

e. Exhaust Valve.

(1) Located on bottom of L. P. chamber.

(2) Simple rubber disc.

(3) Opens during exhalation.

(4) Ambient water pressure keeps it closed otherwise.

f. Purge Valve.

(1) Manually operated button.

(2) Overrides L.P. diaphragm.

(3) Opens L.P. flow valve, clears regulator.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
D. Advantages/Disadvantages of Single Hose Regulator.	List on C.B.	Observe and take notes as necessary.
1. Advantages.		
a. Second stage is always at approximately same pressure as lungs.		
1. Does not have free flowing tendency.		
b. Purge valve allows immediate clearing.		
c. Buddy breathing easier (purge valve & hose).		
d. Reduced water drag.		
e. Stronger intermediate hose.		
f. Generally more rugged piece of equipment.		
2. Disadvantages.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
a. Bubbles sometimes obscure visibility. b. Susceptible to freeze up.		
E. Repair of Single Hose Regulator.		
1. Disassemble and repair a malfunctioning regulator.		
a. Use proper tech manual as guide.		
1. NAVSHIPS 0994-008--100.		
2. U.S. Divers Regulator Repair Manual.		
2. Use of Tools.	Demonstrate proper use of tools.	Observe.
a. Overbottom pressure guage.		
b. Circlip pliers.		
3. Disassembly, Inspection & Reassembly.	Use tech manual (NAVSHIPS 0994-008--100) as a guide. Explain	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
	each step as you disassemble, inspect, reassemble single hose regulator.	Observe. Ask questions as necessary.
4. Same general rules apply as before.		

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NAVAL SCHOOL DIVING AND SALVAGE

SCUBA DIVER A-433-0023

SECURITY CLEARANCE: NONE

LESSON TOPIC 4.3 OPEN CIRCUIT SCUBA CHARGING.

1 1/2 HOURS

INSTRUCTIONAL MATERIALS:

U.S.Navy Diving Manual, VOL. I.

NAVSHIPS INST. 9940.16A

STUDENT GUIDES

OPEN CIRCUIT SCUBA CHARGING CHECK LIST

SCUBA CYLINDERS

CHARGING SYSTEM

TERMINAL OBJECTIVE:

1. When the student completes this course he will be able to demonstrate open circuit SCUBA charging procedures without error.

ENABLING OBJECTIVES:

1. Orally DESCRIBE a typical diver's breathing air system by tracing it from the compressor/flask through the charging lines to the open circuit SCUBA cylinders.
2. Given a standard print of a typical diver's breathing air system, LABEL the physical location of the major components using the proper nomenclature.

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ENABLING OBJECTIVES: (Cont'd)

3. Orally DESCRIBE the interrelation of Charles' Law with charging open circuit SCUBA.

4. Given an open circuit SCUBA charging checklist (for the available system) prepare, activate and secure (after charging) the air supply delivery system.

CRITERION TEST.

1. Given an open circuit SCUBA charging checklist for the available system, demonstrate, as a member of a team, proper open circuit SCUBA charging procedures without error.

HOMEWORK.

Volume C, Student Guide, Information Sheet 4-3-1I, 4-3-2I, 4-3-3I, and 4-4-4I;

Assignment sheets 4-3-1A and 4-3-2A; and Job sheet 4-3-1J

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction to the Lesson:	I.A. Introduce self and topic.	
A. Establish contact	B. Get students ready to learn.	
B. Establish readiness	C. Bring out the need and value of the material being presented.	
C. Establish effect	D. State learning objectives.	
D. OVERVIEW: Upon completion of this lesson you will be able to:	E. State information necessary to guide the students conduct.	
1. Describe a typical divers breathing air system.	1. Questions.	
2. Describe the interrelation of Charles' Law with charging open circuit SCUBA	2. This lesson will be graded and each diver must successfully and safely charge for grade.	
3. Given an open circuit SCUBA charging checklist, prepare, activate and secure (after charging cylinders) the air supply delivery system.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
II. Presentation		
A. Procedures for charging SCUBA cylinders.	A. Explain and show each step in charging. STRESS SAFETY.	A. Observe closely as students will be charging for the next two weeks.
1. Two men (buddies) are required as a charging detail		
2. Insure there is sufficient pressure in the HP banks. Minimum of 2000 PSI reading on the master gauge		
3. Determine what type of cylinders will be charged i.e. 2250 PSI or 3000 PSI cylinders		
NOTE: NEVER MIX BOTH TYPE CYLINDERS IN THE SAME CHARGING LINE	CAUTION WHY? Because of the different pressures involved.	

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
4. Insure all charging hoses are securely locked in the H.P. fittings, and that the hoses are attached to the units to be filled and all secondary relief valves closed	EMPHASIZE	
5. All reserve valves on the cylinder manifolds in the down position.		
6. Main relief valve on the rack closed.		
7. Open all on/off manifold valves.		
8. One man positioned at the main charging valve, the other at the main relief valve.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
9. Insure that all other personnel are kept away from the immediate vicinity of the charging hoses and fittings. (For safety reasons-should a hose suddenly disconnect from the coupling while loaded with H.P. air	CAUTION - EMPHASIZE	
10. Slowly open main charging valve and begin charging at a rate NOT to exceed 40 PSI per minute.		
NOTE: The charging man will not leave his station for any reason until main charging valve has been secured.	CAUTION-EMPHASIZE	
11. Upon reaching maximum rated PSI, main charging		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
11. (Cont) valve is secured		
12. All on/off manifold valves are closed; reserve handles are placed in the up(off) position.		
13. Relief valve man will sound-off with "Bleeding Down" and open the relief valve slowly, insuring that his body is away from the outlet side of the valve from where the residual H.P. air will be exhausting.	EMPHASIZE: SOUND OFF	
14. All charging hoses are disconnected from the SCUBA and masking tape is placed		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
14. (Cont'd) over the inlet orfice on the manifolds this will denote "charged cylinder" to other personnel not involved with the charging detail.		
15. Charging procedures are secured at this time		
III. Charging for grade	QUESTIONS?	
A. Each student will charge for grade.	Charging for grade	Charging for grade.
B. Prefered time for grading is after days diving or during lunch time if diving is carried out before lunch.	A. Supervise each student charging before charging on own.	A. Each student will charge for grade before being allowed to proceed on his own.
IV. Summary and questions.		

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NAVAL SCHOOL DIVING AND SALVAGE

SCUBA DIVER A-433-0023

SECURITY CLEARANCE: NONE

LESSON TOPIC 4.4 PLANNING

1 Hour

INSTRUCTIONAL MATERIALS:

U.S.Navy Diving Manua, Vol I
Student Guides
Standard Classroom Equipment
NAVSHIPS INST. 9940.16A
Ship Repair Safety Checklist
(Appendix. F, U.S.Navy Diving
Manual, Vol. 1)

TERMINAL OBJECTIVE.

1. When the student completes this course he will be able to, given a typical fleet SCUBA diving task, illustrate proper planning procedures by outlining steps necessary for a successful completion of the task.

ENABLING OBJECTIVES:

1. Orally DESCRIBE the application and/or use of open circuit SCUBA diving.

ENABLING OBJECTIVES (Cont'd)

2. Orally DISCUSS, with class members, procedures necessary for proper planning of the 130 ft. qualification dive.

3. USE the pre-dive checklist contained in the U.S.Navy Diving Manual, Vol. 1, for planning the 130 ft. qualification dive.

CRITERION TEST

1. Given the night hull inspection as a typical fleet diving task, demonstrate planning procedures by outlining, in writing, steps necessary (including appropriate checklists) for successful completion of the task, without error.

HOMEWORK

Volume C, Student Guide, Information Sheet 4-4-1I; Assignment Sheets 4-4-1A, 4-4-2A, and 4-4-3A.

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OUTLINE OF INSTRUCTION	INSTRUCTORS ACTIVITY	STUDENT ACTIVITY
I. Introduction to the lesson		
A. Establish contact	A. Introduce self & topic.	
B. Establish readiness	B. Get students ready to learn.	
1. Personal experience.		
C. Establish effect.	C. Bring out the need and value of the material being presented.	
D. OVERVIEW: Upon completion of this lesson you will be able to plan a successful SCUBA operation.	D. State learning objective.	
	E. State information necessary to guide student conduct during class.	
	1. Notes.	
	2. Questions.	

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OUTLINE OF INSTRUCTION	INSTRUCTORS ACTIVITY	STUDENT ACTIVITY
II. Presentation.	II. Presentation.	
A. SCUBA operation	A. Name the eight steps in planning of a SCUBA operation.	
1. Define objectives.		
2. Collect and analyze data.		
3. Establish operational task.		
4. Select diving technique.		
5. Select equipment and supplies.		
6. Select and assemble the diving team.		
7. Make final preparations and check all safety precautions.		
8. Start operation.		
B. Define objectives	B. Cover each step and discuss.	
1. Why the operation is being undertaken?	1. Objective	
2. What is to be accomplished.	Checklist page 4-4	
	Diving Manual	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

C. Collect and analyze data of environmental emergency assistance, and resources.

1. Environmental.

a. Surface conditions.

(1) Surface conditions can be obtained from numerous sources.

(a) Weather messages.

(b) Charts.

(c) Log Books.

(d) Ships equipment.

(e) Tide tables.

(f) OP Orders

(g) Notice to Mariners(etc)

b. Underwater conditions.

(1) Underwater conditions will have a major influence on the selection

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of divers, diving technique and equipment to be used.

The conditions of particular concern are:

(a) Depth

(b) Type of bottom

(c) Tides and currents

(d) Visibility

(e) Temperature

(f) Pollution

(g) Obstacles or hazards

2. Assistance and emergency - 3types of assistance may be required.

a. Emergency assistance in the event of an accident or serious illness.

b. Additional equipment, personnel, supplies or services.

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c. Guidance, authorization or decisions from higher command.

(1) These should include location response time and a contact to each of the following:

(a) Recompression chamber.

(b) Air transportation.

(c) Sea transportation.

(d) Hospital.

(e) Diving Medical Officer

(f) Supplies

(g) Communications.

(h) Diving Units

(i) Command

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

D. Establish Operational Task - A basic outline for the operration so that all tasks in an operation will be apparent. This should be done for even the most routine task. In developing the outline the following points should be taken into consideration.

1. Pre-dive and post-dive activities and safety.
2. Preparation, transit time to the site.
3. Bottom time is always at a premium. Factors affecting bottom time include depth, decompression requirements, number of divers, size of support craft, and environmental condition.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
4. Number and scope of repetitive dives in a given period of time.		
5. If divers have been inactive they should have a work up, starting shallow and progressing to deeper depths.		
6. Plan to work night and day while weather permits, provited sufficient divers ard available.		
7. Using different diving techniques require different levels of support.		
8. The number of divers working at any one time should be kept to a minimum.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

9. Topside support personnel (boat operators, winch operators, and anchor watch, etc) should be properly selected and briefed.

10. Any schedule must be flexible to accomodate unexpected complications, delays, and changing conditions.

11. A diving operation is not completed when the objective has been met. The following must be completed.

    a. Recovery, cleaning, inspection, repair and stowage of equipment.

    b. Disposition of any materials brought up during the operation.

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c. Debriefing the divers and other team members.

d. Analyze the success of the operation, as planned and carried out.

e. Preparation and submission of all required reports.

f. Restocking expended materials.

g. Insuring readiness of the unit to respond to the next assignment.

E. Select proper diving technique — Cardinal Rule

1. Brief recap of SCUBA restrictions. — No Decompression

a. Working limits.

Normal - 60 ft/60 min.

Maximum - 130 ft/10 min.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
b. Current - 1 knot maximum.		
c. Diving team - Min. 4 divers.		
2. Information from the environmental checklist and type of work should be taken into consideration. If safety factors are against the use of SCUBA select a different type of diving equipment.		
F. Select equipment and Supplies		
1. All equipment used in SCUBA diving must be Navy approved.		
2. The 4 main requirements for a divers breathing media.	Chapter 5 Diving Manual.	
a. The air must conform to established standards of purity.		

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b. Adequate volume must be available.

c. The flow to the diver must be sufficient.

d. A back up must be available.

3. Diving Support Craft

a. Must be seaworthy in design and condition.

b. Must be equipped with required lifesaving and other safety gear.

c. Must be in good repair, with a reliable engine.

d. Must have ample room for the divers to dress and rest.

e. Must provide adequate shelter and working area for the support crew.

f. Must be able to safely carry all equipment required for the operation.

g. Must be properly manned by a well trained crew.

4. For SCUBA diving an inflatable rubber boat or runabout may be used. It can move swiftly from diving scene to support craft.

5. Insure diving boat is equpped with items listed in Diving Manual Vol. page 4-23/4-24 on Diving Boat equipment checklist and diving boat safety checklist.

G. Select and assemble the diving team.

1. The Diving Officer.

a. Is in charge of all diving operations and training undertaken by the command.

b. Is responsible for the requalification and safe diving practices of all the divers assigned.

c. Should be a qualified diver.

d. Is responsible for the preparation of basic plans for a diving operation subject to final approval by the Commanding Officer.

e. Coordinates his activities with other departments.

f. Insures a thorough briefing of all personnel involved.

g. He is primarily responsible

for safe conduct of all diving operations.

2. The Diving Supervisor - The man in charge of the actual diving operation and NO DIVING OPERATION MAY BE CONDUCTED WITHOUT HIS PRESENCE.

a. May be an officer or enlisted selection is based on the order of seniority.

(1) Master Diver.

(2) First Class Diver.

(3) Deep Sea Diving Medical Technician.

(4) Second Class Diver.

b. Must be a qualified diver of demonstrated abilities and experience in whom the Commanding Officer has full confidence.

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c. Assists the Diving Officer in preparing for the operation. Using his training and experience plots the operation step by step.

d. He must consider equipment requirements and back up requirements.

e. He should be familiar with the team to evaluate divers qualifications and physical fitness.

f. Inspects all equipment to be used.

g. Conducts pre dive briefings.

h. Monitors progress and updates instructions to working diver.

i. Informs Diving Officer and

and Commanding Officer of progress and any change to original plan.

j. When mission complete, analyze the results and prepare reports for higher authority and any required report from equipment logs to individual diving records.

3. Diving Personnel.

a. Must be qualified for equipment being used and depth of dive.

b. Must keep topside personnel advised as to bottom conditions and any developing problems which may indicate needed change to plan.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
c. Using SCUBA he must keep track of bottom time himself.		
d. The diver is responsible for the gear he will use and must make sure it is in good repair and ready for use.		
e. The standby diver is fully qualified in the equipment used and the depth of diving and be ready to enter the water immediately.		
f. Buddy Diver should always be used when diving SCUBA.		
(1) Each diver keep track of depth and time.		
(2) They are jointly		

assigned for the mission.

(3) Each should watch out for the safety and well being of the other.

(a) Nitrogen narcosis.

(b) Decompression Sickness.

(c) Carbon Dioxide poisoning.

(4) The diver should keep his buddy in sight at all times.

4. Surface crew.

a. Tender is the member of the surface crew who works most closely with the diver.

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(1) He checks the diver over before entering the water.

(2) He constantly tends the line to eliminate slack or tension

(3) Uses line pull signals for communication.

(4) Keeps supervisor informed of depth and movement.

(5) Remains alert for any signs of an emergency.

(6) Should be a qualified diver; if not a diver, it is the responsibility of the Diving Officer and Diving Supervisor to ensure he is

throughly and properly instructed in his duties.

(7) A substitute tender must be briefed on the job prior to taking over the line.

b. Timekeeper.

(1) He maintains worksheets and fills out the diving log.

(2) He records diver's bottom time, decent time, depth of the dive, and monitors the decompression profile.

(3) He usually operates the communication.

(4) Notifies supervisor of lapsed time.

(5) Must have a copy of the USN Standard Decompression Tables.

(6) Must be a qualified diver.

(7) Must not be assigned additional responsibilities.

(8) Should not keep time on more than 2 divers for accuracy.

(9) In SCUBA operations the Diving Supervisor often assumes the duties as timekeeper.

c. Diving Medical Officers and Diving Medical Corpsmen.

(1) Regularly assigned to provide medical advice

and treatment to diving personnel on a routine basis.

(2) They instruct mumbers of the diving team on emergency medical procedures and first aid.

(3) Medical Officer is mandatory when diving below 170 feet.

(4) They certify the fitness of the divers.

(5) Observe conditions of surface support personnel for fatique, overexposure and heat exhaustion.

II. Make final preparations and check all safety precautions.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
1. Prior to commencing actual dive the Diving Officer and Diving Supervisor must review and satisfy themselves that all appropriate preparations have been made. In review these are:		
a. A comprehensive diving plan has been prepared, and all data to the mission has been collected and analyzed for its impact on the operation and safety precautions.		
b. A task schedule has been prepared with diving assignments clearly delineated and the sequence of events determined.		

c. Requirements for both scheduled and emergency logistics support has been arranged.

d. Required equipment has been obtained, checked for proper operation and is on station ready to use.

e. Emergency equipment has been checked for condition and is ready for use.

f. All personnel have been notified of their assignments and a comprehensive briefing has been held.

g. The general safety checklist has been reviewed (appendix J).

h. Onsite emergency checklist has been prepared

and posted.

i. The Diving Officer and Diving Supervisor have been given appropriate authority by the Commanding Officer.

j. The qualifications and physical condition of all divers have been reviewed and certified.

k. Personnel are on station ready to work.

l. The ship or support craft is properly moored and an anchor watch set.

m. Weather conditions are satisfactory for diving operations.

n. Higher authority has been notified of the operation,

other ships in the vicinity and the Harbor Master has been notified (if appropriate).

o. Proper visual signals are displayed.

p. The Officer of the Deck has been notified, he in turn notifies the Commanding Officer and the Engineering Officer and has been given "Permission to commence Diving Operations".

(1) If diving on or around a ships hull a Ships Repair Safety Checklist must be completed. The following items are contained in the checklist.

(a) Word to be passed over the IMC every 30 min. "There are divers working over the side, do not operate any equipment, rotate screws, cycle rudder, planes or torpedo tube shutters, take suction from or discharge to sea, blow or vent any tanks, activate sonar or underwater electrical equipment, open or close any valves or cycle trash disposal unit before checking with the Diving Supervisor".

(b) It is followed by the

Supervisors name and rate.

(c) Upon completion of Diving Operations, pass this word over the IMC- "Diving Operations are completed, normal and routine work may be carried on in accordance with previous instructions".

(d) The time, ship, and date diving operations are to commence.

(e) Nature of diving operations.

(f) Diving operations will commence until the signature of the following

personnel (as required) has been obtained.

(g) Repair activity - Repair Officer, CDO, OOD, SQD, OPS. Officer.

(h) Ships alongside - OOD of all ships alongside. Insure the ships are not getting underway and main circulating pumps are not open.

(i) Ship being worked on - Engineering Officer, OOD.

j) Insure the following is tagged out - rudder, planes, torpedo shutters, trash disposal unit, tank blows, tank vents, shaft

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
locked, sea suctions, sea discharges, underwater electrical equipment, sonars U/W electrical equipment not listed.		
(k) Issue appropriate diving signal is displayed and removed on completion.		
(l) The checklist will be signed by the Diving Supervisor before commencing diving if he is satisfied it is safe.	QUESTIONS	

OUTLINE INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
D. Enter the water and line up 90° to target. E. Commence swimming on signal and have 20 mins. to complete	Instructor and corpsman in workboat, assistant instructor in runabout. B. Give signal to go and the students have 20 minutes to complete C. Instructor will pick up students at the end of swim in the workboat. D. Runabout will moniter advance swimmers and workboat will follow up.	Student rep. step enter the water and line up 90° to target B. On signal commence swimming to target and complete within 20 min. C. At end of swim enter workboat.
IV. Recap why make a 1000 yard swim.		

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NAVAL SCHOOL, DIVING AND SALVAGE

SCUBA DIVER A-433-0023

SECURITY CLEARANCE: NONE

LESSON TOPIC 4.6 Underwater Compass Swim

6 Hours

INSTRUCTIONAL MATERIALS

U.S. Navy Diving Manual
NAVSHIPS INST 9940.16A
UDT Handbood
Student Guides
Standard Classroom equipment
SCUBA Face mask
SCUBA Swim fins
Life vest
Wet suit
Work boat
Runabout boat
Diving Flags
Knife
Flares
AMBU
Regulator
Twin 90's or 72's SCUBA cylinders
Compass

TERMINAL OBJECTIVE

1. When the student completes this course he will be able to, in open water, swim 500 yards underwater with open circuit SCUBA, as a member of a team, on a compass course arriving at a designated point.

ENABLING OBJECTIVE

1. DEMONSTRATE the setting and use of an underwater compass.

2. SWIM 500 yards underwater with open circuit SCUBA, as a member of a team, on a compass course, arriving at a designated area.

CRITERION TESTS

1. In open water, swim 500 yards underwater, using open circuit SCUBA, as a member of a team, on a compass course, arriving at a point designated by the instructor.

HOMEWORK
Volume C, Student Guide, Information Sheet 4-6-1I, 4-6-2I and 4-6-3I; Assignment Sheet 4-6-1A; Job Sheet 4-6-1J and 4-6-2J.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. INtroduction to the lesson:	I.A. Introduce self & topic	
A. Establish contact.		
B. Establish readiness	B. Get students ready to learn	
	1. Motivate.	
C. Establish effect	C. Bring out the need and value of the material being presented.	
D. <u>OVERVIEW</u>: Upon completion of this lesson you will be able to:	D. State learning objectives	
1. Explain the procedures for the use of an underwater compass in diving with open circuit SCUBA	E. State information necessary to guide the students conduct.	
2. Demonstrate the use of an underwater compass while swimming with open circuit SCUBA.	1. Questions	
	2. The project is graded and the divers must arrive at a designated point.	
II. Presentation.		
A. Parts of compass	Use chart to show location	Observe and take notes as necessary
1. Lubbers line		
a. Permanently fixed on face of compass		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
b. Aligns compass & Divers body.		
2. Compass card	Use chart to show location	Observe and take notes as necessary
a. Inside oil filled compartment.		
b. 4 points, North, East, South, West		
c. North usually marked by arrow.		
d. North on arrow always points to mag. north.		
e. Diver rotates under compass card.		
(1) Explain,		
Example Ship		
f. Allow it to settle out a few seconds.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
3. Compass Bezel	Use chart to show location	
a. Turnable - like watch bezel.		
b. Marked by dot, arrow or		
c. Reference point shows course deviation.		
4. Compass case.	Use chart to show	
a. Holds parts of compass.		
b. Bearing circle.		
1. 10^{o} increments - 360^{o} total.		
2. Explain reverse numbering system		
c. Plastic or rubber material.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
5. Wrist strap	Use chart to show	
a. Rubber or nylon.		
b. 1 piece strap (Explain)		
c. Positive buckle		
B. Use of Underwater Compass.		
1. Worn on wrist or swim board.		
a. Describe swim board.		
2. Line up lubbers line with body.	Demonstrate step by step and use chart to show.	
3. Line up lubbers line on objective.		
a. Let compass card settle.		
4. Rotate Bezel, Aligning Bezel Mark with magnetic North (N-Compass Card)		

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5. Commence swimming.
   a. Keep lubbers line and body in line.
   b. Keep Bezel mark and North lined up
   c. Keep compass level.
6. Laying out course
   a. Never perpendicular to current.
   b. Explain set caused by cross currents.
   c. Explain reverse course.
      1. Subtract 180° from original course

C. Compass Swims (500 yards)

1. Lay out compass course.
2. Students dress
3. Enter the water from workboat and swim for designated target.

Questions on use of compass.

1. Lay nut compass course with or against the current, never across.

Compass Swims

1. Dress in open circuit SCUBA with buoy.
2. Take initial bearing from workboat.
3. Enter the water.

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OUTLINE INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
4. On completion swim to workboat	2. Check out divers and put in water	4. Check bearing.
	3. Assistant instructor in runabout following first swimmers	5. Commence swim.
	4. Pick up swimmers at end of swim	6. On completion swim to workboat if close.
	5. Critique on swim to correct problems.	7. Straighten equipment for off loading.

NAVAL SCHOOL, DIVING AND SALVAGE

1195

SCUBA DIVER A-433-0023

Security Clearance: None

Lesson Topic 4.7 - Clearing, Ditching and Donning Open Circuit SCUBA

17 Hours

INSTRUCTIONAL MATERIALS:

U.S.Navy Diving Manual
NavShips Inst. 9940.16A
SCUBA face mask
SCUBA swim fins
Life vest
Snorkel
Wet suit top (if water temp is below 78°)
Double 90's or 72's SCUBA cylinders
Regulator
Weight belt and weights
Knife

TERMINAL OBJECTIVES

1. When the student completes this course he will be able to demonstrate procedures for clearing open circuit SCUBA without error.

2. When the student completes this course he will be able to demonstrate proper procedures for ditching and donning open circuit SCUBA, in accordance with the U.S.Navy Diving Manual.

TERMINAL OBJECTIVES (Cont'd)

3. When the student completes this course he will be able to, in open water, swim to a depth of 130 feet using open circuit SCUBA.

ENABLING OBJECTIVES:

1. In a swimming pool, first at a depth of four feet and then at a depth of at least nine feet, using open circuit SCUBA, DEMONSTRATE:

   a. The ability to breathe underwater.
   b. The top pressure face mask clearing procedure.
   c. The side pressure face mask, clearing procedure.
   d. Single/double hose regulator clearing procedure.
   e. Buddy breathing.

2. In a swimming pool, first at a depth of four feet and then at a depth of at least nine feet, using open circuit SCUBA, DEMONSTRATE ditching and donning procedures in accordance with the U.S. Navy Diving Manual, Vol. I.

ENABLING OBJECTIVES (Cont'd)

3. In a swimming pool, at a depth of at least nine feet, using open circuit SCUBA, DEMONSTRATE the front step method of water entry.

4. In a swimming pool, at a depth of at least nine feet, using open circuit SCUBA, DEMONSTRATE the ability to remain submerged under adverse conditions by properly responding to instructor imposed emergency situations (i.e. elimination of air supply, removal of equipment, etc.) in accordance with Diving Training Standards.

5. In open water, at a depth of at least ten feet, using open circuit SCUBA DEMONSTRATE:

   a. The ability to breathe underwater.
   b. The top pressure face mask clearing procedure.
   c. The side pressure face mask clearing procedure.
   d. Regulator clearing procedure.
   e. Buddy breathing.

6. In open water, at a depth of at least ten feet, using open circuit SCUBA, DEMONSTRATE the front step method of water entry.

7. In open water, at a depth of at least twenty feet, using open circuit SCUBA, and proper tools, COMPLETE the Single Flange Project in accordance with Diving Training Standards.

8. In open water, at a depth of at least twenty feet, as a member of a two-man team, using open circuit SCUBA and proper tools, COMPLETE the Two-Man Flange Project in accordance with Diving Training Standards.

CRITERION TESTS.

1. In a swimming pool, at a depth of at least nine feet, using open circuit SCUBA, ditch and secure all SCUBA gear (except life vest), surface, recover and don gear, clearing the mask and regulator, in accordance with the U.S. Navy Diving Manual.

2. In open water, swim to a depth of 130 feet using open circuit SCUBA.

HOMEWORK

Volume C, Student Guide:

Day 1 - Assignment Sheets 4-7-1A, 4-7-2A, and 4-7-3A; Job Sheets 4-7-1J, 4-7-2J, 4-7-3J, and 4-7-4J.

HOME WORK (CONT'D)

Day 2 - Assignment Sheets (Phase II) 4-7-1A and 4-7-2A; Job Sheets (Phase II) 4-7-1J, 4-7-2J, 4-7-3J, 4-7-4J and 4-7-5J.

Day 4 - Assignment Sheet (Phase III) 4-7-1A; Job Sheets (Phase III) 4-7-1J, 4-7-2J, 4-7-3J, 4-7-4J, 4-7-5J and 4-7-6J.

Day 8 - Job Sheets (Phase IV) 4-7-1J and 4-7-2J.

OUTLINE IN INSTRUCTION	INSTRUCTORS ACTIVITY	STUDENT ACTIVITY
I. Introduction to the lesson.	I.	
A. Establish contact	A. Introduce self & topic	
B. Establish readiness:	B. Get students ready to learn	
1. Personal experience	1. Motivation	
C. Establish effect.	C. Bring out the need and value of the material being presented.	
D. OVERVIEW: Upon completion of this lesson you will be able to demonstrate proficiency by surface swimming with a mask, snorkel, fins, and lifejacket.	D. State learning objectives.	
	E. State information necessary to guide student conduct during the lesson.	
	1. Notes.	
	2. Questions.	
	3. Information testable.	
II. Presentation:	II. Presentation	
A. With fins, mask, snorkel, life vest.	Explain to the students how each exercise is to be conducted	Student listen closely.
B. Clear snorkel with mask on.		
C. Clear mask using 2 methods.		
1. Front method.		

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OUTLINE IN INSTRUCTION	INSTRUCTORS ACTIVITY	STUDENT ACTIVITY
2. Side method.		
D. Clear mask and snorkel.		
E. Swim with snorkel		
F. Water entry with fins, mask, snorkel, life vest.		
G. Water entry mask on bottom.		
III. Instructor Rep Step - Clearing snorkel.	Questions. A. Demonstrate clearing snorkel by submerging until snorkel is loaded, surfacing and exhaling through the snorkel to blow out the water.	Student observe closely
IV. Student Rep Step - Clearing snorkel.	Instructor observe students and correct mistakes	Student will submerge until snorkel is flooded, surface and exhale through the snorkel to blow out the water.

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OUTLINE OF INSTRUCTION	INSTRUCTORS ACTIVITY	STUDENT ACTIVITY
		Continue until student becomes proficient in clearing the snorkel. Student observe closely.
V. Instructor Rep Step - Clearing mask	A. Demonstrate clearing mask using front method. 1. Fill mask in place, lean head back, use slight pressure on the top of mask and exhale through the nose until mask is clear.	
	B. Demonstrate clearing mask using side method. 1. Fill mask in place, lean head to the side, apply pressure to the side on top exhale through the nose until	

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
VI. Student RepStep - Clearing mask.	mask is clear. Instructor observe students and correct mistakes	A. Student will submerge and fill mask, surface, using the front method, and exhale through the nose until mask is clear. Practice clearing until proficient. B. Clear mask using front method while submerged. C. Student will submerge and fill mask, surface using the side method exhale through the nose until mask is clear.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
		Practice clearing until proficient.
		D. Clear mask using the side method while submerged.
VII. Instructor Rep Step for clearing mask and snorkel	A. Submerge, fill mask and snorkel with water, surface, clear snorkel by exhaling rapidly through mouth, then clear mask using side or front method.	Students observe closely.
VIII. Student Rep Step for clearing mask and snorkel	Instructor observe closely and correct mistakes	Student will submerge, fill mask & snorkel, surface, clear snorkel, Clear mask. Practice clearing snorkel & mask until proficient.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
IX. Instructor Rep Step - Swimming with snorkel only.	A. Swim face down using snorkel only, mask pulled down around neck.	Student observe closely.
X. Student Rep Step - Swimming with snorkel only	Instructor observes closely and correct mistakes	Students swim face down using snorkel only, mask pulled down around neck.
XI. Instructor Rep Step - Water Entry	A. Step to the side of the pool. B. One hand on mask. C. One hand on waist strap of life vest to simulate cylinder harness. D. Lean slightly forward. E. Take large step into water. F. Upon surfacing indicate	Students observe.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
	to instructor/supervisor Okay.	
XII. Student RepStep - Water Entry.	Instructor observes students and corrects mistakes.	A. Students step to side of pool. B. One hand on mask. C. One hand on waist strap of life vest. D. Lean slightly forward. E. Take large step into water. F. Upon surfacing indicate to instructor/supervisor okay.
XIII. Instructor Rep Step - Water Entry, Mask on bottom.	A. Step to side of the of the pool, mask on bottom. B. Proper water entry. C. Clear mask on bottom. D. Surface and signal (7) Okay.	Students observe

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
XIV. Student Rep Step - Water Entry, mask on bottom.	Instructor closely observe students and correct mistakes.	A. Step to the side of the pool, mask on bottom. B. Proper water entry. C. Clear mask on bottom. D. Surface & signal okay.
XV. Summary	Question students on why we did the above steps and answer any questions.	Ask any questions and answer questions asked by instructors.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction to the lesson:	I.A. Introduce self-& Topic	
A. Establish contact		
B. Establish readiness:	B. Get students ready to learn.	
1. Personal experience	1. Motivate.	
C. Establish effect.	C. Bring out the need and value of the material being presented	
D. Overview: Upon completion of this lesson you will be able to demonstrate proficiency in breathing underwater, clearing facemask using front and side method, regulator clearing procedures, water entry, and ability to swim using SCUBA equipment.	D. State learning objectives.	
	E. State information necessary to guide student conduct during the lesson.	
	1. Questions.	
	2. Testable.	

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
II. Presentation: A. Breathing underwater with SCUBA in shallow end of pool. B. Clearing face mask using front and side methods. C. Clearing of regulator D. Water entry in SCUBA equipment. E. Ability to swim in SCUBA equipment.	Explain to students how each exercise is to be conducted.	Students listen closley
III. Instructor Rep Step - Breathing under water with SCUBA equipment.	Instructor Rep Step - Breathing underwater with SCUBA equipment. A. Enter water by backing down ladder, mask around neck, fins in hand.	Students enter water using ladder, using mask observe instructor.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
	B. Put mask on, regulator in mouth and submerge. Sit with back to side of pool.	
IV. Student Rep Step - Breathing underwater with SCUBA equipment	Observe students and correct mistakes	Student RepStep - Breathing underwater using SCUBA Equipment. A. Enter water with SCUBA mask around neck, fins on arms, back down ladder and take a place on the pool edge. B. Place mask on face, requlator in mouth, fins on arm. C. Submerge with back to side of pool.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
		D. Continue till all students appear comfortable.
V. Instructor Rep Step - Clearing mask using front and side methods	Demonstrate front and side methods of clearing mask using SCUBA	Observe closely.
VI. Student RepStep - Clearing mask using front and side methods.	Observe students and correct mistakes.	Student RepStep clearing mask using front and side methods. A. Students clear mask using both methods. B. Continue until proficient.
VII. Instructor Rep Step - Regulator clearing procedures.	Instructor Rep Step - Regulator clearing procedures. A. Double hose. 1. Submerge.	Observe instructor clearing regulator.

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2. Remove mouth piece from mouth to flood.
3. Place mouth piece in mouth.
4. Roll to left side.
5. Squeeze off the inhalation hose(right).
6. Blow through the mouth piece which forces the water out the exhaust tube(left hose).
7. Release inhalation hose and take a shallow breath. There may be water still trapped in the mouth piece.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
	8. If water remains, blow again. B. Single hose regulator 1. Submerge. 2. Remove mouth piece from mouth to flood. 3. Press purge button as you put mouth piece in mouth.	
VIII. Student Rep Step - Regulator Clearing procedures.	Observe students and correct mistakes.	Student Rep Step - Regulator clearing procedures. A. Double hose. 1. Submerge. 2. Remove mouth piece from mouth and flood. 3. Place mouth piece in mouth.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
		4. Roll to left side.
		5. Squeeze off the inhalation hose (right hose)
		6. Blow through the mouth-piece which forces the water out the exhaust tube (left hose).
		7. Release inhalation hose and take a shallow breath. There may be water still trapped in the mouthpiece.
		8. If water remains, blow again.
B. Single hose	B. Single hose	B. Single hose
		1. Submerge.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
		2. Remove mouthpiece from mouth to flood. 3. Press purge button as you put mouthpiece in mouth.
IX. Instructor Rep Step - Water entry	Instructor Rep Step-Water entry A. Step to the edge of the pool in SCUBA gear. B. One hand holding mask and regulator. C. One hand holding waist strap of SCUBA harness. D. Leaning slightly forward, take a large step into the pool.	Students observe on edge of pool.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
	E. Check out buddy F. Signal supervisor okay.	
X. Student Rep Step - Water entry.	Observe students and correct mistakes.	Student RepStep - Water Entry. A. Step to the edge of the pool in SCUBA gear. B. One hand holding mask and regulator. C. One hand holding waist strap of SCUBA harness. D. Leaning slightly forward, take a large step into the pool. E. Check out buddy-straps reserve-leaks.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
		F. Signal supervisor okay.
XI. Instructor Rep Step - Swimming in SCUBA	XI. Instructor RepStep- swimming in SCUBA A. Explain proper swimming techniques and demonstrate 1. Legs straight. 2. Arms at side.	XI. Instructor Rep Step - Swimming in SCUBA. A. Listen and observe from the side of the pool.
XII. Student Rep Step - Swimming in SCUBA	A. Observe Students and Correct mistakes	Student RepStep - Swimming in SCUBA A. Commence Swimming using proper techniques until proficient.
XIII. Summary	XIII Question Students on why we did the above steps and answer any questions	Ask questions as necessary. Respond to questions as directed.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction to the lesson:	I.A. Introduce self and topic.	
A. Establish contact		
B. Establish readiness:	B. Get students ready to learn.	
1. Personal experience	1. Motivate.	
C. Establish effect.	C. Bring out the need and value of the material being presented.	
D. <u>OVERVIEW</u>: Upon completion of this lesson you will be able to demonstrate proficiency in buddy breathing.	D. State learning objectives.	
	E. State information necessary to guide student conduct during the lesson.	
	1. Questions.	
	2. Testable.	

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
1. Buddy breathing is strictly an emergency procedure (loss of air or other malfunction). That must be practiced in advance of the need so that every diver is thoroughly familiar with the procedure. Its' a sharing of of a buddys' air supply.	Explain to Students how each exercise is to be conducted.	Students line up at the shallow end of the pool, and listen closely.
a. Remain calm and signal the problem to the buddy by pointing at your mouthpiece.	Demonstrate procedures as discussed	Observe
b. Do not grab for the buddys' mouthpiece. The diver places his hand over the hand which the buddy is using to hold the mouthpiece.		

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The diver and his buddy should hold on to each other by grasping a strap or free arm.

c. The buddy must make the first move by taking the mouthpiece from his mouth after taking a breath and passing it to the diver. The diver will then guide it to his mouth. Both divers will maintain direct hand contact on the mouthpiece.

d. The mouthpiece may have flooded during the

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
transfer. It must be cleared either by use of the purge button (single hose) or exhaling sharply before a breath is taken.	Emphasize CAUTIONARY Measures	
e. The diver should take two full breaths (exercising caution in the event that all of the water has not been purged) and hand the mouthpiece back to the buddy. The buddy should then take two breaths, and the cycle is repeated.		
f. The diver taking the breaths may become more bouyant than		

the other. The divers must be careful not to drift away from each other. If using a double-hose regulator the mouthpiece MAY be kept slightly higher than the regulator so that free-flowing air will keep the mouthpiece clear.

g. The divers should repeat the breathing cycle and establish a smooth rhythm. No attempt should be made to surface until the cycle is stabilized and the proper signals have been exchanged.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
h. During ascent the diver without the mouthpiece MUST exhale slowly to offset the effect of decreasing pressure on the lungs.	EXTREME CAUTION	
	Questions	
2. Instructor Rep Step	Instructor Rep Step	Instructor Rep Step
	a. Two instructors submerge and demonstrate the front to front method	a. Student Submerge and observe closely.
	b. Side to side method	b. Ask Questions on completion
	c. Piggy back method of swimming with the diver who lost air on the back of the diver who has air.	
3. Student Rep Step	Student Rep Step	Student Rep Step

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
	a. Observe students closely b. Correct mistakes	a. Students submerge and commence buddy breathing using the front to front method. Continue until proficient. b. Use the side to side method until proficient. c. Use the piggy back method swimming around the pool until proficient.
4. Recap	Recap Questions on why we conducted this exercise.	Recap

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
1. Ascent, Emergency (Ditching). If a diver is suddenly without air or if his SCUBA is entangled he must make an emergency free ascent. The proper procedure is: a. Ditch weight belt. b. If the SCUBA has become entangled and must be ditched, trip the quick release buckles on the waist and one shoulder strip (left shoulder preferred for single hose regulator) and roll the SCUBA off the other arm. An alternate method is to trip waist strap and flip the SCUBA over	Explain to the students how the exercise is to be conducted.	Students line up at the shallow end of the pool and listen closely.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
the head and pull out from underneath. Exercise care that hoses do not tangle on the neck. Some single hose units have neck straps, they tend to complicate the ditching procedure and should not be used.		
c. NEVER DITCH THE SCUBA UNLESS ABSOLUTELY NECESSARY. During ascent, the pressure differential between the air in the cylinders and the air in the medium pressure chamber of the regulator will increase. This may permit some of the air remaining in the cylinders to be	EMPHASIZE	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
supplied to the diver.		
d. If a diver is unconscious and his buddy has trouble carrying him to the surface, he may inflate his life vest to lighten the load the buddy should never lose direct and secure contact with the diver.		
e. During Ascent - Exhale continuously. Let the expanding air in the lungs freely escape.	EMPHASIZE: Give example of embolism to get point across.	
2. Pool Procedures	QUESTIONS	QUESTIONS
a. In a seated position the diver pulls the quick release straps on the SCUBA.	Pool Procedures. Explain pool procedures for ditching and donning.	
(1) Waist strap - for over		

the head removal.

(2) Waist and left shoulder straps - for off the right shoulder removal.

b. Holding the manifold with one hand the diver pulls the SCUBA up and over the head while guiding the tanks with the other hand.

c. Once over the divers head he shifts his grip to the center of the tanks and lowers them between his legs.

d. Release the weight belt and place on the SCUBA below the waist to hold it on the bottom.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

e. Shift to a face down position, legs away from the SCUBA, keeping as low as possible to prevent free-flow of regulator.

f. Staying as low as possible remove swim fins and place one under each cylinder, to prevent them from floating away.

g. The diver then removes his mask and places it on top of the SCUBA.

h. He then takes a breath, turns off his SCUBA and tucks his mouth piece under the manifold.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
i. The diver assumes an upright position and commence exhaling and starts his ascent. He must continuously exhale during ascent.		
j. Breathe, submerge and don in reverse procedure of ditching.	QUESTIONS	
3. Instructor Rep Step	Demonstrate each step in proper sequence. a. Submerge. b. Assume sitting position. c. Unfasten waist strap. d. Lift SCUBA over head and place in front, between legs.	Submerge and observe instructor.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
	e. Remove weight belt and place over SCUBA.	
	f. Assume face down position, remove swim fins, and place one under each cylinder.	
	g. Remove face mask and place on top of SCUBA.	
	h. Take a breath, turn off SCUBA and place mouthpiece under the manifold.	
	i. Stand up, begin exhaling and begin ascent exhaling continuously to the surface.	
	j. Get a breath of air and submerge.	
	k. Don equipment in reverse order of ditching.	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
4. Student Rep Step	Student Rep Step Observe students in ditching and donning in the shallow end of the pool. Instructor will insure that student is exhaling prior to leaving bottom of pool and that he continues to exhale all the way to the surface. QUESTIONS	Student Rep Step a. Together with buddy commence practice ditching and donning in the shallow end of the pool using proper sequence. b. After both buddys have successfully completed ditching and donning in the shallow end, move to the deep end of the pool for more practice. QUESTIONS

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DIVING TRAINING STANDARDS

TASK: SCUBA HARPASSMENT (4.7, Phase III)

UNIT: 1. SCUBA
2.
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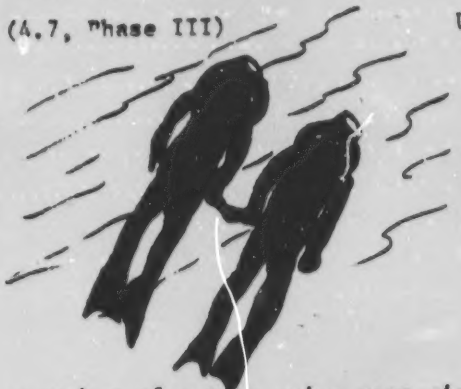

GENERAL DESCRIPTION: As a member of a team using open circuit SCUBA equipment, in a swimming pool, student divers will remain submerged while responding to instructor imposed emergency situations.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Swimming Pool		
2. DEPTH	deepest area at least nine feet		
3. EQUIPMENT	1. Open Circuit SCUBA gear (Double Hose Regulators)		
4. OTHER			

STANDARDS:

1. PERFORMANCE	1. Remain submerged until exercise is over or both team members exhaust their primary air supply		
2. TIME	None		
3. EQUIPMENT	None		

PROCEDURES:

1. Teams will make a normal water entry - air valve secured at the stop valve, face mask on the bottom of the pool at the deepest part.
   a. After entry, divers turn air on, clear regulator.
   b. Recover, clear and don facemask.
   c. Team members check each other for equipment alignment and operation. Make adjustments as necessary.
   d. After determining everything is "Go", both team members signal the instructor and swim off as a team.
2. Teams will circle the pool in a counter-clockwise direction remaining submerged.
3. Team members will ignore any activity regarding other teams. At no time will team members engage in harrassment of other teams.
4. Team members will assist each other during the emergency situations which will be imposed by the instructors. Remember - this is the culmination of your SCUBA training in the pool, and, as such, is testing you on your acquired skill and knowledge of SCUBA equipment and your understanding of emergency procedures.

INSTRUCTOR PROCEDURES:

1. Following situations are to be imposed on the student divers in order to test their knowledge and skill. Instructors should not become so overly enthusiastic during harrassment that there would be a possibility of equipment damage or an accident involving a student. KEEP THE SITUATIONS REALISTIC.

   a. Flood/Remove Facemask
   b. Loss of air (by squeezing hose or securing valve)
   c. Undo straps on the cylinder harness
   d. Loss of weight belt
   e. Loss of swim fins
   f. Buddy Breathing
   g. Life Jacket Inflation (Last Resort)

WHY DO IT:

This exercise aids the student in developing confidence in himself as a SCUBA diver and in his equipment.

SKILLS NEEDED:

Proficiency in the use of SCUBA equipment.

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SPECIAL INSTRUCTIONS:

1. Do not black out facemasks.
2. At least one member of a team must have air at all times.
3. When both team members are on reserve, divers will orally inflate their life jackets, come to the surface, and swim until the harrassment exercise is completed.
4. Student divers are not allowed to rest on the side of the swimming pool (in or out of water) at any time during harrassment.

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DIVING TRAINING STANDARDS

TASK: SINGLE FLANGE

UNIT: 1. SCUBA
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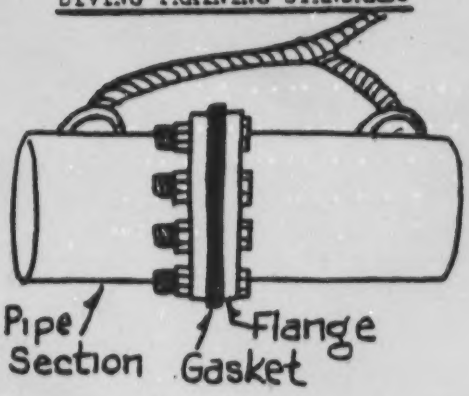

GENERAL DESCRIPTION: Diver descends to the bottom , disassembles and reassembles, with gasket, the Single Flange Project.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Water		
2. DEPTH	at least 30 feet		
3. EQUIPMENT	1. Open Circuit SCUBA gear. 2. Tool bag & 2 open-end wrenches.		
4. OTHER	None		

STANDARDS:

1. PERFORMANCE	None		
2. TIME	Within 20 minutes		
3. EQUIPMENT	1. Bench marks aligned. 2. At least six nuts and bolts wrench tight.		

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PROCEDURES:

1. Disassembling:

   a. Descend project to the bottom.
   b. Diver descends to bottom using descent line. Use proper visual signals upon entering the water and line-pull signals when leaving the surface and thereafter until returning to the surface.
   c. Diver removes nuts, bolts and gasket.
      (1) Put nuts and bolts in the tool bag.
   d. Use line-pull signals and send for square mark.
   e. Secure gasket to square mark and send it topside.
   f. Recover gasket from topside.

2. Reassembling:

   a. Reassemble flange in reverse order making sure bench marks are aligned and gasket is in place.

WHY DO IT:

To acquaint the student with minor jobs underwater and the requirement for a water tight flange fitting.

SKILLS NEEDED:

1. Basic mechanical skills.
2. Be able to overcome the restrictions created by the SCUBA systems.

SPECIAL INSTRUCTIONS:

1. Time starts when the diver reports he is on the bottom and has located the project.
2. Time stops when the diver signals for the project to be hauled topside.
3. Instructor must insist on proper line-pull signals throughout the dive.

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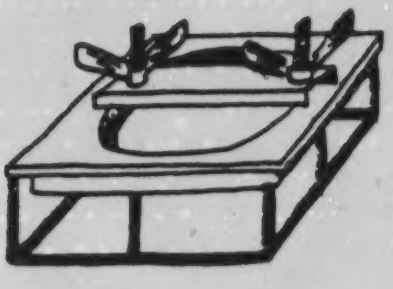
DIVING TRAINING STANDARDS

TASK: TOOKER PATCH PROJECT

UNIT: 1. SCUBA
2.
3.



GENERAL DESCRIPTION: Diver removes and replaces a strong back in a Tooker Patch.

CONDITIONS:	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Water		
2. DEPTH	at least 20 feet		
3. EQUIPMENT	1. Open circuit SCUBA		
4. OTHER	None		

STANDARDS:			
1. PERFORMANCE	None		
2. TIME	within 10 minutes		
3. EQUIPMENT	1. Patch properly seated.		

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PROCEDURES:

1. Place the project on the bottom on a project whip.
2. Diver descends to bottom and locates the project.
3. Diver removes two wing nuts from patch studs.
4. Diver removes the strong back.
5. Diver requests square mark from topside, secures strong back to square mark and sends it topside.
6. Receive strong back from topside and reassemble project.

WHY DO IT:

1. Gives student experience securing tooker patch such as are used in port holes during salvage operations.

SKILLS NEEDED:

1. Basic mechanical

SPECIAL INSTRUCTIONS:

1. Time starts when diver reports that he is on the bottom (via ling-pull signals),
2. Time stops when diver reports that he is leaving the bottom.

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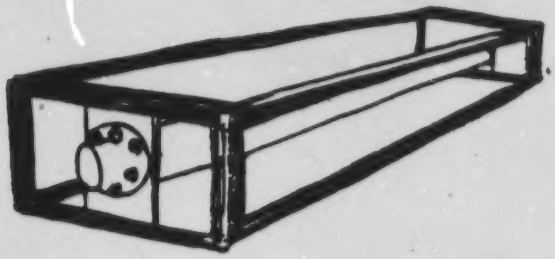
DIVING TRAINING STANDARDS

ASK: TWO MAN FLANGE

UNIT: 1. SCUBA
2.
3.



GENERAL DESCRIPTION: Divers locate and reassemble a double flange .

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open water		
2. DEPTH	at least 20 feet		
3. EQUIPMENT	1. Open Circuit SCUBA 2. Tool Bag 3. Wrenches		
4. OTHER	None		

STANDARDS:

1. PERFORMANCE	None		
2. TIME	Within 25 minutes		
3. EQUIPMENT	Seven nuts and bolts are to be wrench tight.		

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PROCEDURES:

1. Place project on the bottom on a project whip.
2. Two divers descend to the bottom and locate project.
   a. Divers will use proper line-pull signals throughout dive.
3. Each diver disassembles a flange and removes the rubber gasket.
4. Diver #1 requests a square mark from topside.
5. Diver #1 secures both gaskets to the square mark and sends them topside.
6. Recover gaskets.
7. Both divers replace and secure the gaskets with ten nuts and bolts.

WHY DO IT:

Teaches the student diver team work while assembling/disassembling pipe sections.

SPECIAL INSTRUCTIONS:

1. Time starts when both divers report that they are on the bottom.
2. Time stops when diver #1 calls for the project to be hauled topside.
3. Instructor must insist on proper line-pull signals throughout the dive.

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NAVAL SCHOOL DIVING AND SALVAGE

SCUBA DIVER A-433-.023

SECURITY CLEARANCE: NONE

LESSON TOPIC 4.9 - Night Bottom Search

8 Hours

INSTRUCTIONAL MATERIAL

U.S. Navy Diving Manual, Volume I
Student Guides
NAVSHIPS INST. 9940.16A
Open Circuit SCUBA
Face Mask
Swim Fins
Wet Suit
Weight Belts
Life Vest
Knife
Flare
Strobe Light
Cylinder and Manifold Assembly
Regulator
Depth Gauge
Diving Light
Circling Line (Buoy, Buoy line weight, swim line)
Jackstay line (2 buoys, 2 buoy lines, 2 weights, swim line)
Tending Line
Object of Search

TERMINAL OBJECTIVE

1. When the student completes this course, he will, in open water, at night, using open circuit SCUBA, as a member of a

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TERMINAL OBJECTIVES (CONT'D)

two-man team, recover a specified object from a depth of at least 30 feet using a circling line, within thirty minutes.

ENABLING OBJECTIVES

1. Orally DEFINE terms used in circling line, jack stay and surface tended methods of bottom searching using open circuit SCUBA.

2. Orally EXPLAIN the usage of the circling line, jack stay and surface tended methods of searching.

3. DEMONSTRATE procedures for assembling equipment and setting a circling line.

4. Using circling line and jack stay techniques, CONDUCT searching exercises during daylight hours, recovering a specified object from the bottom.

5. Use proper surface tended searching procedures and signals during open circuit SCUBA training activities.

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LESSON TOPIC 4.9 Night Bottom Search (Cont'd)

CRITERION TEST

1. Open water, at night, using open circuit SCUBA, as a member of a two-man team, recover a specified object from a depth of at least 30 feet using a circling line within thirty minutes.

HOMEWORK

Volume C, Student Guide, Information Sheet 4-9-1I thru 4-9-5I; Assignment Sheet 4-9-1A; Job Sheets 4-9-1J thru 4-9-5J.

OUTLINE OF INSTRUCTION	INSTRUCTORS ACTIVITY	STUDENT ACTIVITY
I. Introduction to the lesson A. Establish contact B. Establish readiness 1. Personal experience C. Establish effect D. OVERVIEW: Upon successful completion of this lesson you will, in open water, at night, using open circuit SCUBA, as a member of a two man team, recover a specified object from a depth of at least 30 feet using a circling line, within 30 min.	I. Introduction to the lesson. A. Introduce self and topic. B. Get students ready to learn. 1. Motivate. C. Bring out the need and value of the material being presented.	
II. Presentation A. 3 main searching methods. 1. Tended search - small to intermediate areas		

OUTLINE OF INSTRUCTION	INSTRUCTORS ACTIVITY	STUDENT ACTIVITY
a. Restricted by length of tending line.		
b. Restricted by placement of diving platform.		
2. Circling line search		
a. Small to intermediate areas.		
b. Tended or untended.		
3. Jack stay search.		
a. Intermediate to longer areas.		
B. Tended search.		
1. Surfaced tended from diving platform.	Use chart to show	Observe and take notes as necessary
a. Use standard Navy searching signals.		

OUTLINE OF INSTRUCTION	INSTRUCTORS ACTIVITY	STUDENT ACTIVITY
b. Tending line - long enough to cover search area		
c. Tending line kept taut.		
d. Answer all signals.		
C. Circle line search		
1. Describe components.	Illustration. Locate	
a. Buoy - purchased or improvised.	each component	
b. Buoy line - strong enough to retrieve clump.		
c. Clump - hand hoistable.		
(1) Heavy enough diver wont accidently drag it.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
d. Circle line or swim line. (1) 20' long (ours) (2) Knotted every 5' (3) Must rotate free on buoy line. e. 360° marker buoy - Hand moveable.		
2. Method 1. a. Diver descends on buoy line. b. Locates swim line. c. Diver searches, 360° sweep on 1st knot. d. Diver moves out to 2nd knot (1) Searches 360° sweep.	Show on chart.	

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e. Continue until object is found.

3. Method 2.

a. Diver descends buoy line.

b. Locates swim line.

c. Swims to last knot.

d. Commences 360° sweep.

(1) Searching 4 dragging swim line low, attempting to snag object.

e. Move in 1 knot, after each 360° sweep, until object is found.

4. Method 3.

a. For good visability only.

b. One diver swims at 2nd knot.

c. Other diver swims at 4th knot.

d. Divers make 360° sweep.

D. Jack stay search.

1. Describe components.

a. 2-buoys - purchased or improvised.

b. 2 buoy lines - strong enough to return clump.

c. 2 clumps - hand hoistable.

(1) Heavy enough diver won't accidently drag them.

d. Jackstay or search line.

(1) Long enough for desired search.

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(2) Bottom conditions, visibility influence length.

2. Method 1 - Rectangular search.

a. Diver descends buoy #1.

b. Searchs along jackstay line to buoy #2.

c. Moves Buoy #2 in direction of search

d. Search back to buoy #1.

e. Moves buoy #1 in direction of search.

f. Continue until object is recovered.

g. Distance buoy is moved is influenced by:

(1) Bottom conditions

(2) Visability.

OUTLINE OF INSTRUCTION	INSTRUCTORS ACTIVITY	STUDENT ACTIVITY

3. Method 2 - Circular Search.

   a. Buoy #1 is stationery.

   b. Buoy #2 is mobile.

   c. Diver descends Buoy #1

   d. Searches out to Buoy #2.

   e. Move buoy #2 in direction of search.

   f. Search back to Buoy #1

   g. Search back to Buoy #2

   h. Move buoy #2 in direction of search

   i. Continue until object is found or 360° sweep.

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OUTLINE OF INSTRUCTION	INSTRUCTORS ACTIVITY	STUDENT ACTIVITY
III. Open water evolutions.	III. Open water evolutions	A. Circling line.
A. Circling line.	circling line	1. Prepare equipment.
	1. Transport students to search area	2. Drop weight with buoy line and buoy.
	2. Drop search object into area	3. Diver(s) enter the water and swim to the buoy.
	3. Commence time	4. Signal okay & descend.
	4. Stop time when diver arrives on the surface with the object	5. On arrival at weight attach swim line.
		6. Commence one of the searches in the presentation.
		7. Upon finding object attach line and bring to the surface.
		8. Have next diver ready to go when diver comes up ladder.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
		9. Continue until all divers have made a search.
B. Jack stay search	B. Jackstay search	Jackstay Search
	1. Transport divers to the search area.	1. Prepare equipment.
	2. Manuever boat while laying jackstay.	2. Lay jackstay- Drop No. 1 weight with buoyline, buoy and jackstay line attached.
		3. When line is payed out lower No 2 weight over the side. Keep a strain on buoy line until all slack is out of the jackstay line, then let go of the buoy line with buoy attached.
	3. Drop search object in water.	4. Divers enter the water and swim to the buoy,

OUTLINE IN INSTRUCTION	INSTRUCTORS ACTIVITY	STUDENT ACTIVITY.
		Signal okay and submerge.
		5. Commence search as pre planned. Moving weights in the pre-planned direction.
		6. On locating search object, surface.
	4. Recover diver(s) when on the surface	7. Next diver(s) be ready to go when the first set comes in to the boat.
		8. Continue until all divers make a search.

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DIVING TRAINING STANDARDS

TASK: NIGHT UNDERWATER SEARCH

UNIT: 1. SCUBA
2.
3.

GENERAL DESCRIPTION: Surface tethered SCUBA diver recovers an object from the bottom during the hours of darkness, using a modified circling line technique.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Water		
2. DEPTH	at least 30 feet		
3. EQUIPMENT	1. Open Circuit SCUBA		
4. OTHER	1. At night 2. Surface Tethered		

STANDARDS:

1. PERFORMANCE	1. Must find object and bring it to the surface		
2. TIME	Within 20 minutes		
3. EQUIPMENT	None		

PROCEDURES:

1. The instructor will plant the descent line with attached buoy marker. Circling line will be attached to the clump.
2. Tethered SCUBA diver enters the water, gives proper signals and swims to the descent line.
3. Diver uses proper line-pull signals and descends to the bottom.
4. Diver locates circling line and begins searching pattern.
5. Tender will move the diver, via line-pull signals, in a pattern of 360 degrees as illustrated below.

NOTE: It is important that the tender instruct the diver to change direction at the position indicated by the dotted line in order to prevent fouling of lines.

6. When the diver finds the object, he will notify the tender by line-pull signals. Tender will standby to assist the diver in coming to the surface and securing the object of search.
7. Diver uses proper line-pull signals and comes to the surface bringing the object with him.

WHY DO IT:

1. This project gives the student experience in searching for objects on the bottom at night using SCUBA gear and circling line technique.
2. This project increases the student's confidence in himself and the SCUBA gear.

SKILLS NEEDED:

1. Proficiency in the use of SCUBA gear.

SPECIAL INSTRUCTIONS:

1. Object of the search will be at least as large as one half a SCUBA bottle.
2. Object will be placed on the bottom by the instructor.
3. Time starts when the student leaves the surface.
4. Time stops when the student returns to the surface with the object.
5. Instructors should not insist that students use searching line-pull signals. This is to be a surface <u>teathered</u> search (vice surface <u>tended</u>). The tender's function is one of safety only.

NAVAL SCHOOL DIVING AND SALVAGE

SCUBA DIVER A-433-0023

Security Clearance: None

Lesson Topic 4.10 Underwater Hull Inspection

7 Hours

Instructional Material:
U.S.Navy Diving Manual, Vol. I
Student guides
Standard classroom equipment
NAVSHIPS INST. 9940.16A
Underwater Works Techniques Manual, Vol.I
Calipers
Slate
Overhead projector
Transparency of: Ship hull
Submarine hull
Propellars
Rudders and shafts
Inspection reports

Open Circuit SCUBA Equipment:

Facemask
Swim fins
Wet suits
Weight belts

Instructional Material (Cont'd):

Open Circuit SCUBA Equipment (Cont'd)

Life vest
Knife
Flare
Strobe light
Cylinder and manifold assembly
Regulator
Depth gauge
Diving lights

Terminal objective

#1. When the student completes this course he will be able to, as a member of a team, in open water, at night, using open circuit SCUBA, conduct, a detailed underwater hull inspection of a designated craft. File a written report with the Instructor which specifies propellars, shafting, rudders, sonar equipment, underwater fittings, and general hull conditions to include applicable measurements, marine growth and other specifics as instructed.

ENABLING OBJECTIVES

1. Orally explain the function(s) of a detailed underwater hull inspection.

2. Given an illustration of a typical Navy submarine and surface vessel, LOCATE points included in a detailed underwater hull inspection, describing measurements taken and conditions observed during such an inspection.

3. Given a description of a typical surface vessel hull, WRITE an inspection report using proper terminology, measurement data and organization.

4. In open water, in daylight, as a member of a team and using open circuit SCUBA, CONDUCT a detailed underwater hull inspection on an available craft. Provide a verbal report to the instructor.

CRITERION TEST

As a member of a team in open water at night, using open circuit SCUBA, conduct a detailed underwater hull inspection of a designated craft. File a written report with the instructor which specifies propellors, shafting, rudders, sonar equipment underwater fittings, and general hull conditions to include applicable measurements, marine growth and other specifics as instructed.

HOMEWORK

Voume C, Student Guide, Information Sheet 4-10-1I thru 4-10-10I; Assignment Sheets 4-10-1A and 4-102A; Job Sheet 4-10-1J thru 4-10-4J.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction to the lesson:	Introduction to the lesson. Introduce self and topic.	
A. Establish Contact:		
B. Establish Readiness:	Get students ready to learn Motivate	
1. Personal experience.		
C. Establish effect:	Bring out the need and value of the material being presented	
D. Overview: When the student completes this lesson topic, he will be able to, as a member of a team, in open water, at night, using open circuit SCUBA, conduct a detailed underwater hull inspection of a designated craft. File a written report with the instructor which specifies propellers, shaftings, rudders, sonar equipment, underwater fittings and general hull conditions to include applicable measurements, marine growth and other specifics as instructed.	State learning objectives	
	State information necessary to guide students conduct during the lesson.	
II. Presentation.		
A. Hull inspection.		
1. Complete examination of underwater hull.		
a. Access condition of hull.		
b. Discover damage to hull.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

2. Ships hulls have various configurations.

    a. Basic hull inspection techniques are the same.

3. Hull inspections normally involves many departments.

4. May include UDATS underwater television survey.

5. Always review last hull inspection report.

6. Use - SHIP REPAIR SAFETY LIST.

    a. Locate diving boat in closest possible proximity to work.

    b. Take tidal currents into consideration as to boat location & starting point.

7. U/W lights are a must.

B. Typical Hull Inspection Route.

1. Rudder, Inspect following:

    a. Rudder clearance.

        (1) Distance between top of rudder & hull.

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(2) Measure with inside calipers.

b. Rudder plugs.

(1) 2 or 4, located at corners

(2) Insure they are secure.

c. Overall physical condition.

(1) Paint.

(2) Gouges, scrapes, dents.

(3) Cracked welds.

(4) Damage from foreign object.

d. Inspect rudder post retainer ring.

(1) Check bolts.

(2) Check locking wire.

(3) Supports packing gland, failure causes flooding.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

2. Propeller(s) & strut assembly.

a. Dunce cap.

(1) Insure its secure

(2) Check cover plate for looseness.

b. Propeller(s)

(1) Inspect each blade for:

(a) Nicks.

(b) Dents.

(c) Cracks.

(d) Clips.

(e) Curls.

(2) Inspect faces for cavitation effects.

(a) Indicated by small pock marked holes.

(3) Determine overall condition.

(a) Sea growth, barnnacles

(b) Corrosion.

(4) Reporting propeller damage

(a) Numbering blades.

(1) Start at lifting padeye plug.

(2) Blades are number 1-2, etc,going clockwise.

(3) Standing Aft looking forward.

(b) Distingush between leading & trailing edge.

(c) Point out hub.

(d) Use a slate if necessary.

WARNING: Do NOT bump blades with SCUBA BOTTLES

c. Rope guards (forward)

(1) Explain purpose

(2) Illustrate them.

(3) Inspect for.

(a) Loose screws, general security

(b) Wire or line inside.

d. Struts (Primary & Secondary)

(1) Struts support Shaft.

(2) Inspect following.

(a) External Damage, overall physical condition.

(b) Condition of zincs.

1. Overall security.

2. Line or wire inside.

e. Shaft.

(1) Inspect as following.

(a) External damage, Overall physical condition

(b) Inspect protective rubber coating.

f. Stern tube

(1) Inspect following:

(a) Aft fair water.

(b) External damage, overall physical condition.

(c) Inspect dead lights.

1. Look for wire or line.

2. Look at shaft.

g. Repeat as # of propellers require.

3. ENGINEERING SPACES

a. Safety precautions.

(1) Insure diver can surface safely.

(a) 2' clearance minimum

(2) Insure suctions/ discharges are secured.

b. Keel & bilge keel

(1) Inspect for damage.

(2) Check zincs, on or near bilge keel.

c. Sea suctions.

(1) Main circulating pump suction.

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(a) Amid ships - large.

(b) Inspect for sea growth and fouling.

(c) Inspect security of grating.

(2) Main inspection scoop.

(a) Forward of main circ. pump suction.

(b) Inspect for sea growth and fouling.

(c) Inspect security of grating.

(3) Other suctions and discharges.

(a) Inspect for sea growth and fouling.

(b) Inspect security of grating.

d. Sonar Dome.

(1) 2 types.

(a) Hull configured mount.

(b) Keel mounted.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

(2) Inspect following.

(a) External damage, overall physical condition.

1. Sea growth.

2. Dents, cracks, scratches.

3. All welded joints.

4. All bolts & fairing strips

5. Peeling paint.

(b) Cover entire dome.

(1) Face.

(2) Bottom.

(3) Both sides.

e. Bow or stern.

(1) Inspect following

(a) Damage, over physical condition.

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HULL INSPECTION IS DONE

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

C. Hull inspection Report.

1. List items to be inspected.

2. Includes diagrams to show damage.

3. Contains following.

   a. Rudder

   b. Propeller(s)

   c. Struts, shift, stern tubes, fair waters.

   d. Sea chests/suctions

   e. Zincs

   f. Sonar dome

   g. Hull

   h. General remarks

4. Made up locally (different for)

   a. Surface slips.

   b. Submarines

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DIVING TRAINING STANDARDS

TASK: Underwater Hull Inspection

UNIT: 1. SCUBA
2.
3.

GENERAL DESCRIPTION: Team of divers conduct a detailed underwater hull inspection of an available craft, taking appropriate measurements and filing a subsequent report.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Water		
2. DEPTH	at least 20 feet		
3. EQUIPMENT	1. Open Circuit SCUBA 2. Measuring Instruments (see reverse)		
4. OTHER	1. Night		

STANDARDS:

1. PERFORMANCE	None		
2. TIME	None		
3. EQUIPMENT	1. File an accurate report on specified equipment.**		

** Accuracy may be checked with ship's blueprints.

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PROCEDURES:

General: Although active fleet ships have a wide variation in hull size and configuration, hull inspections are generally quite similar in procedure. It is possible to describe a technique for hull inspections applicable in most respects to all ships. As is true in the case of all underwater tasks, thorough planning is the key to successful execution of the job. This is especially important in the case of hull inspections since the entire underwater hull and all appurtenances are included, with most of the ship's activities involved. Accordingly, the preparation of the plans in written form is especially desirable.

Task: Underwater hull inspection involves the examination of the entire exterior underwater hull and appurtenances to determine the condition and the need for repairs. When available, it includes closed circuit television coverage of the inspection to assist the evaluation of the inspection.

When tidal current is not a factor, the inspection may start at the stern or at the bow depending on preferences or physical conditions. When tidal current is a factor, the direction is chosen on the basis of facilitating the work and providing the best security for the diving team and the boat. In this description the inspection is started at the stern because this is the preference of most tender and repair ship divers. Two divers are usually used, each inspecting half of the ship from stern to the bow and with one diver working to port and one to starboard.

The divers will generally take their air supply from the air flasks in the boat, in a fleet job. This is a matter of equipment availability, condition of the equipment, boat storage, working space and preference.

Technique: Prior to beginning inspection, the past underwater hull history should be reviewed with particular attention to previous paint conditions, gouges, dents, scrapes, appurtenances and any other points requiring scrutiny.

(1) Tag-out procedure
(2) Provide lights as required

Rudder:

Take rudder clearance measurements with inside calipers for comparison with previous readings to determine sag. Measurement is made between the forward uppermost part of the rudder and the nearest hull surface. See illustration for representative examples of clearances.

Check the rudder plugs. Sometimes there are four, sometimes two - one at the top and one at the bottom. Insure that the plugs are in place and secure.

Check the overall physical apprearance for cracks in the welds, cracks in rudder surfaces, gouges, scrapes, and any marks which iddicate the rudder has contacted some foreign object.

Sound the rudder for possible flooding by tapping on the surface. (Secure plugs and a good physical appearance should indicate that there has not been any flooding, but the tapping test provides added insurance).

Check the rudder post retainer ring bolts with their associated safety wiring. These should be secure since they retain the ring which supports the packing gland around the post.

Propellers:

Check the dunce cap to insure that it is secure in place.

Check the cover plate halves aft of the propeller for their physical appearance and security.

Locate the eyebolt-fitting plug in the hub of the propeller. Insure that the plug is in place and secure. Use this plug as a standard or zero point for numbering the blades on the propeller. Number each blade in succession clockwise as the propeller is viewed from the stern towards the bow. The first blade is #1, the next is #2, the next #3, and so forth, until all blades are numbered. The purpose of numbering the blades is to compare the previous reports on blade conditions with the current inspection findings.

Check the overall physical appearance of each blade starting with #1. Inspect the peripheral edge for nicks, curls, chips, cracks or other apparent damage. Use the ruler to measure apparent damage as practicable.

Inspect the face and back for cavitation effects. These effects can be identified by little pocked holes on the blade surface.

Check the rope guard forward of the propeller for security in place and corrosion.

Struts to Stern Tube:

Check the external primary strut housing and primary strut for apparent damage, such as gouges, nicks, cavitations, etc.

Several types of ships have zincs located on the hull above the V-shape of the main strut running fore and aft. As the inspection progresses from the propellers, check the zincs. (Zincs may be bolted or welded in place). Deterioration is usually most severe at the after end. Note the percentage of zincs remaining.

Check the fairwater halves at the forward end of the primary strut for rigidity, security and any apparent damage. Fairwaters are in two halves and are usually secured by screws or welded or both.

Swim forward on the shaft taking constant note of the Protective Rubber Coating (PRC) conditions. This coating may be sprayed rather than wrapped like tape.

Inspect the fairwater aft of the secondary strut in the same manner as the inspection of the other fairwater in step above.

Inspect the external secondary strut housing and secondary strut. This is a repeat of the first step of strut inspection.

Repeat step above for inspection of the fairwater forward of the secondary strut housing.

Continue up the shaft and check the PRC condition all the way to the stern tube fairwater.

Check the fairwater on the stern tube, as above.

Inspect the external housing of the stern tube. Check the dead lights in the stern tube to see if it is clear within the tube. Dead lights are oblong holes which have a race track shape. (Some ships do not have dead lights).

Note:

If one diver is conducting the inspection, duplicate steps for the rudder, propeller, and struts on the opposite side at this time.

Regardless of the number of propellers (1 or 4), the number of struts (1 or 2) or even if the propeller is configured directly to the hull, the sequence indicated for the rudder, propeller and struts need be modified only to the extent of eliminating those steps which are not applicable.

Engineering Underwater Space:

Prior to diving for inspection of engineering underwater spaces, check again to insure free water around the hull for diver safety. A minimum positive clearance of two feet should be assured. This clearance is not a problem in those situations where a ship is at anchor or "Med" moored (stern to the pier) or nested together with camel standoffs between the nested ships.

Inspect the bilge keel. The illustration shows that the bilge keel is generally located in the center half of the ships, usually extending from the after most engineering fireroom forward to the area abreast of the ship's bridge area. Check the bilge keel for apparent damage. The leading or forward edge usually is the part which is most susceptible to roll back or damage. As the inspection progresses along the bilge keel, check for the material condition of the zincs. In some cases, zincs may be at either end, or one end only, or in the middle, or just above the bilge keel and parallel to it. Note the percentage of zincs remaining.

Next, proceed to the vicinity of the main scoop injection and locate it by having a member of the ship's force sound the hull with a slow, steady tapping noise from within. Check for marine growth or anything which may foul the gratings. Check the gratings for security.

Repeat the same procedure for the main circulation pump suctions.

Inspect any other hull openings in the engineering spaces as specifically requested by the ship or which may be seen along the inspection route.

Note: If only one diver is performing the inspection (not in school situation) duplicate the Engineering Underwater Inspection for the otherside, including bilge keel and zincs. Then proceed forward to the bow area to inspect the sonar dome, as applicable.

If two divers are inspecting, one diver proceeds to the sonar dome on the side he is inspecting. The other may secure.

Sonar Dome (As Applicable):

While proceeding forward to inspect the sonar dome, locate the draft markings on the bow. Follow the markings downward to the sonar dome at the keel. Inspect the dome. Check the face, the bottom, the port and starboard sides for general freedom from growth, scratches, marks, and damage. Also check the condition of the fairing strip where bolts secure the dome to the hull. The older types of sonar are bolted to the hull; the newer or later models are either welded to the hull or configured as part of the hull at the bow.

Note: If the sonar dome is configured to the hull at the bow, swim forward from the bilge keel to the ship's keel. Inspect the keel for bad growth, peeling or loose paint forward to the hull configured sonar.

Inspect the hull configured sonar dome. Check the face, the bottom, the port and starboard sides for general freedom from growth, scratches, marks, pitting and other apparent damage.

Ship's Keel and Stem:

When the keel mounted sonar dome inspection is completed, extend forward and swim alongside the keel, inspecting for bad growth, peeling or loose paint.

Follow the keel up to the stem. Inspect the stem for any distortion or other apparent damage. Inspection is completed; clear the water.

Complete and submit the required inspection report in accordance with directions from the instructor.

WHY DO IT:

This gives the student experience in performing a task that he will be required to perform as a diver as well as building his confidence in the use of SCUBA gear through its use and the night environment.

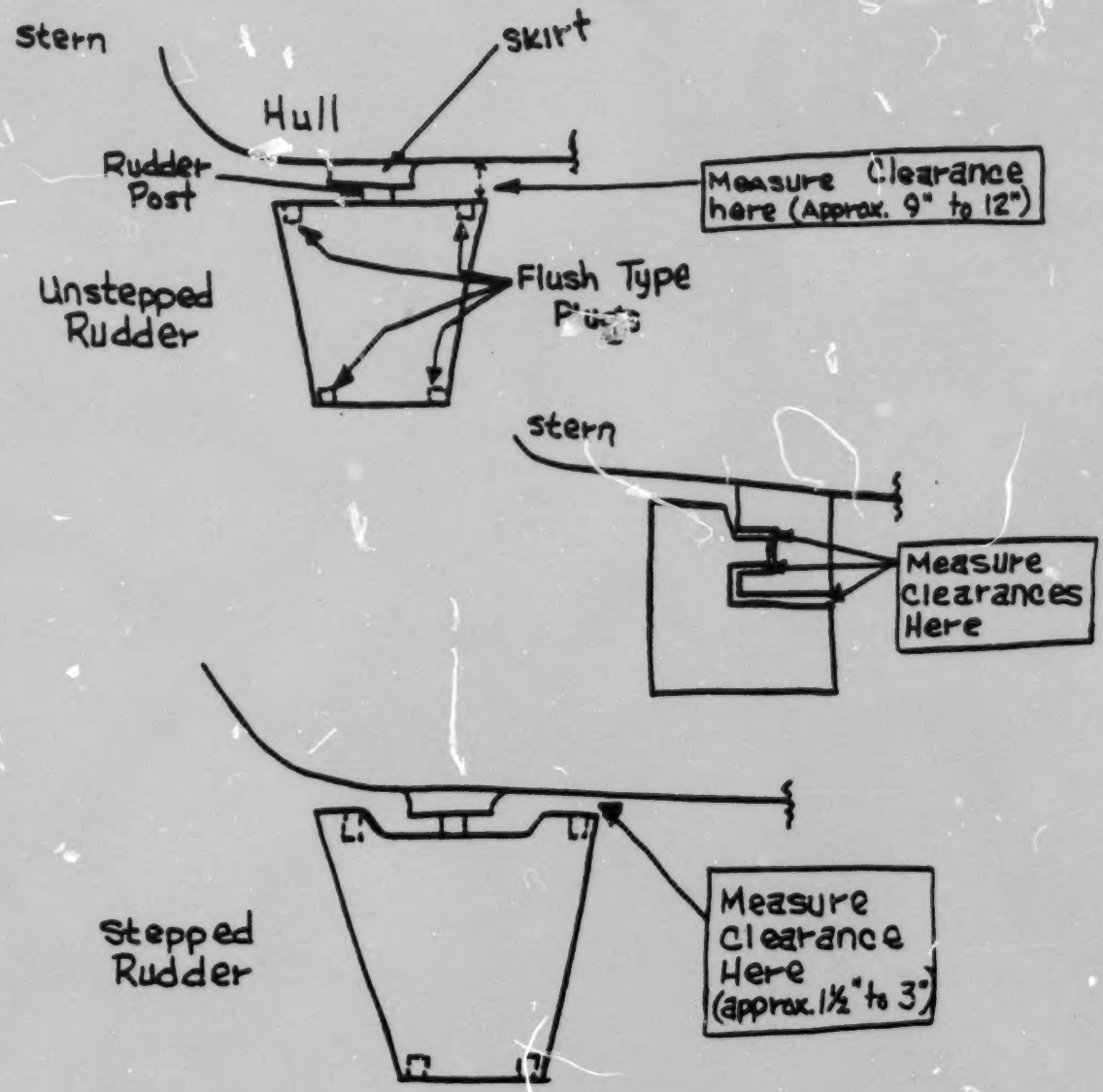
SKILLS NEEDED:

Skill in the use of the measuring instruments.

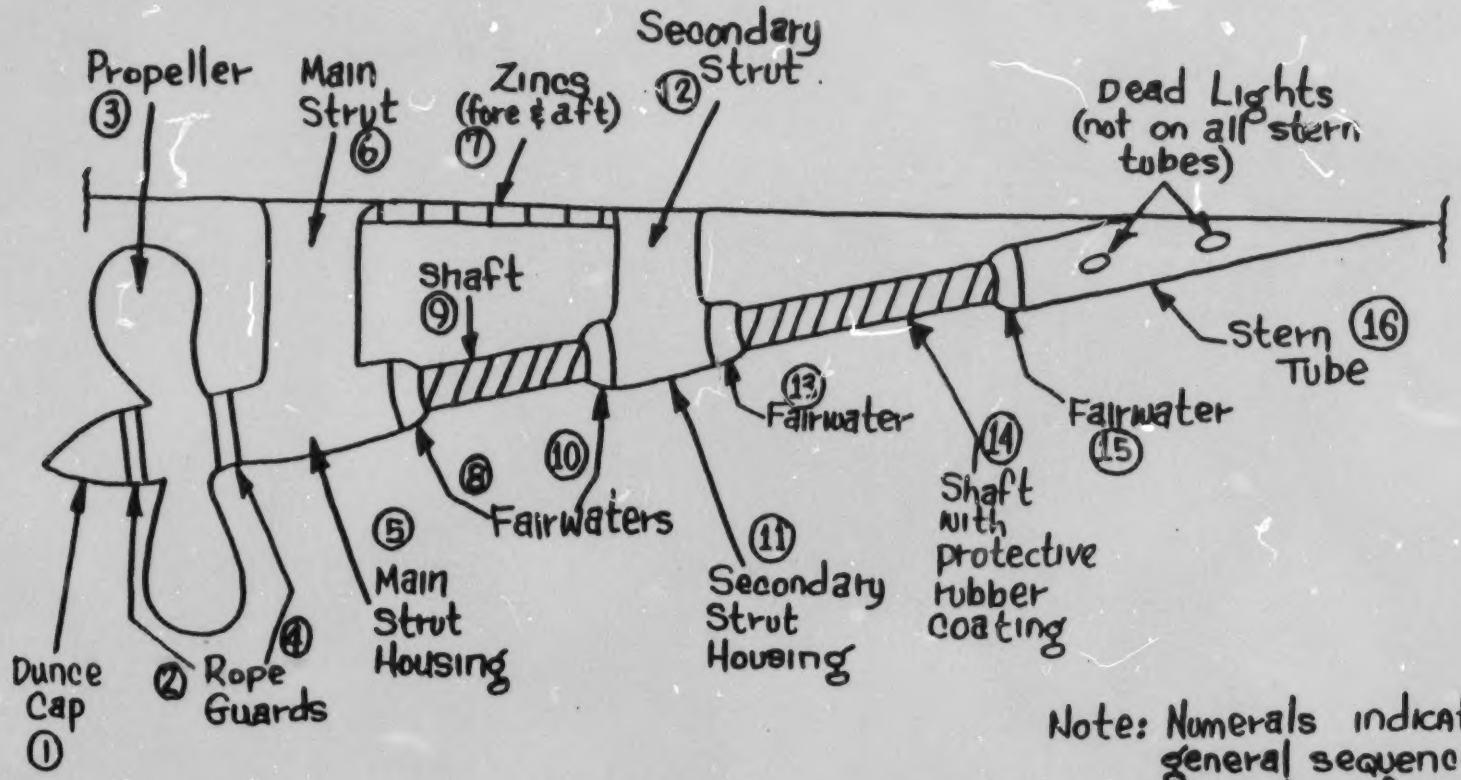
SPECIAL INSTRUCTIONS:

1. Depending upon the size of the class, it may be necessary to give a team of two divers a specific portion of the underwater hull inspection as opposed to the entire inspection. This does not circumvent the intent of the project so long as both divers are required to perform measurements and to file a report.

Procedures for this project are extracted from: Underwater Work Techniques Manual, Volume 1, Underwater Inspection, Maintenance and Repair of Naval Ships, pp 215 - 223.



Examples-Rudder Clearance



Note: Numerals indicate general sequence for inspection from stern to bow for any single propeller/shaft with two struts.

Typical Propeller-Strut Assembly

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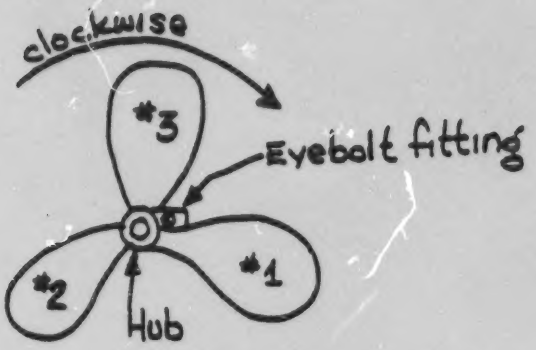
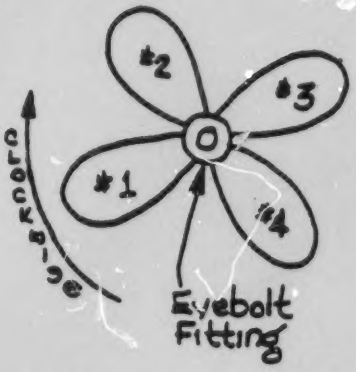
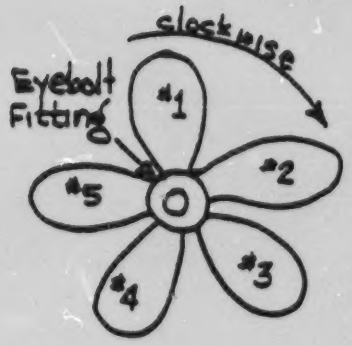


3-Bladed Propeller



4-Bladed Propeller



5-Bladed Propeller

Examples - Blade Numbering

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UNDERWATER HULL INSPECTION REPORT

An inspection of the underwater hull of the USS _____ was performed on _____ with the following conditions noted:

Rudder

Clearance measurement:

Plugs:

Sounding:

Posts:

Surface Condition:

Remarks:

Propeller

Condition of each blade (by number):

Dunce Cap:

Rope Guard:

Remarks:

Bilge Keel

Condition:

Remarks:

Struts:

Condition:

Remarks:

Fairwaters

Condition:

Remarks:

Stern Tube

Housing:

Remarks:

Sea Chests

Remarks:

Zincs

Missing:

Deteriorated:

Intact:

Remarks:

Sonar Dome (as applicable)

Surface condition:

Welded Seams:

Remarks:

Hull

Paint:

Growth:

Dents, damage:

Remarks:

General Remarks:

signed:_____

NAVAL SCHCOL DIVING AND SALVAGE

SCUBA Diver A-433-0023

Security Clearance: NOne

Lesson Topic 4.11 General Safety Precautions

3 1/2 Hours

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual, Vol. I

Student Guides

Standard Classroom Equipment

Safety Center SCUBA Diving Slide

PRESENTATION (includes script)

References: NAVSHIPS INST. 9940.16A
Diving and Salvage
Safety Notes 1971/72

TERMINAL OBJECTIVE

Partial attainment of the following:

1. When the student completes this course he will be able to demonstrate a knowledge and understanding of safety precautions required in the use of open circuit SCUBA through the strict adherence to and usage of safety precautions applicable to the open circuit SCUBA diving training activities.

NOTE: Safety is an integral phase of all diving theory, systems and practical activity. It is difficult to separate items in order to enumerate specific safety precautions as Enabling Objectives for this Terminal Objective. Therefore, many items of safety will be found in their respective sections concerning theory, systems and practical diving operations. The following safety items are those not specifically elaborated upon elsewhere.

ENABLING OBJECTIVES

1. Orally DESCRIBE the specific safety precautions involved in the following possible diving situations using open circuit SCUBA:

   a. diving on ships in a nest

   b. diving using explosives

   c. diving on a submarine hull

   d. diving during propellor changes

   e. diving in heavy currents

   f. diving in extreme cold water

   g. diving in polluted water

   h. diving in enclosed spaces

   (specifically to elaborate

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ENABLING OBJECTIVES (CONT'D)

upon the dangers of toxic gases)

CRITERION TEST

None

HOMEWORK

Volume C, Student Guide Information
Sheet 4-11-1I

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction to Lesson	I. Introduction to Lesson	
A. Establish Contact	A. Introduce self and topic.	
B. Establish readiness	B. Get students ready to learn.	
1. Personal experience		
C. Establish effect	C. Bring out the need and value of the material being presented.	
D. Overview: Upon completion of this lesson you will be able to describe the specific safety precautions involved in the following diving situations:		
1. Diving on ships in a nest		
2. Diving using explosives		
3. Diving on a submarine hull		
4. Diving during propellor changes		
5. Diving in heavy currents.		
6. Diving in extreme cold water		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
7. Diving in polluted water		
8. Diving in enclosed spaces		
II. PRESENTATION		
A. Ships in a nest	SHOW & EXPLAIN ITS USE	
1. Ship repair safety list		
a. filled out, signed, adhered to		
b. All ships will be tagged out		
2. Code Alfa.		
a. Displayed by ship being worked on		
b. Displayed out board ship		
c. and as necessary		
3. Camels		
a. Describe Camel		
b. Must be between ships		
4. Berthing or shifting berth		
a. No ships will shift berth		
b. or come along side during Diving ops.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

5. Maintain free access to surface
   a. Use surface tend or descent line
6. Diving Platform
   a. Close as possible to work area.
7. Diving Supervisor
   a. Must brief divers and ships personnel of Diving operation.
   b. Communications must be maintained with all personnel concerned.

B. Diving Using Explosives

1. Supervisor must have complete control.
   a. Accomplished by retaining
      1. Firing key
      2. Time fuse

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2. 300 PSI Shock Wave or Greater.
   a. Will damage lungs
   b. Will damage intestines
   c. 300 PSI shock = 1 lb. charge - 48 ft. from diver
3. Anticipation of under water Explosion
   a. Leave water if possible
   b. If not float face up
   c. Keep head, chest, & intestinal cavity up & out of water.

C. Diving on Submarines
1. Nuclear Submarines - Radiation Hazard
   a. Contact radiological officer, plan dive.
   b. Wear water proof film badge

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. All submarines		
a. Use ships repair safety list.		
D. Propellor Changes		
1. Quiet Moor is highly desirable	ILLUSTRATE	
2. Secure work stage adequately		
3. Diving team and crane operator must be throughly briefed.		
4. Illustrate chain fall method		
a. Diver controls chain fall		
b. Fall stowed in oil bath		
5. SHIPS REPAIR SAFETY LIST		
a. Must be used		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
E. Heavy Currents		
1. 1 knot - Max. SCUBA Ops.		
2. Use tending line		
3. Have safety boat available		
4. TOP PHYSICAL CONDITION		
5. Stay clear of under strain.		
6. Rip Tide		
a. Ride it out, do not fight it	ILLUSTRATE	
8. Approach job sight from down stream		
F. Open Sea Diving Ops.		
1. Gather all available information.		
a. Navagation Charts, depth, bottom conditions.		
2. Monitor weather reports.		
3. Radio/Comm with base		
4. Safety Boat		
5. Minimum Moor 2 Point Moor		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
6. 1st Divers Down check anchors	ILLUSTRATE	
7. TOP PHYSICAL CONDITION		
8. Emergency Plan for casualty		
a. Emergency check list 4-13 DVM		
G. Cold Water Diving Ops		
1. TOP PHYSICAL CONDITION		
2. Use proper protective gear		
a. DVM- Page 4-10 - fig. 4.9		
3. SHORT bottom times		
a. Accustom diver to cold water slowly		
4. Respiration rate higher than normal		
a. Increased danger of CO_2 build up		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
5. Water Entry - Enter slowly		
a. Increased danger of uncontrollable hyperventilation		
b. Can lead to unconsciousness.		
6. Do not neglect topside personnel.		
H. Diving Polluted Waters		
1. Sources		
a. Sewer discharges -	Discuss	
b. Industrial discharges - chemical/high temperature		
c. Petroleum leaks - skin irritation		
2. Use protective clothing		
3. Guard against ingestion of water		
4. Appropriate prevention medial procedure.		

a. Shot card up to date

5. Increased vulnerability to:

a. Ear infections

b. Skin infections

6. Extreme warm water ops.

a. Be alert for heat exhaustion.

I. Closed spaces

1. SCUBA is never used to enter a closed space.

2. All closed spaces must be:

a. Vented before entered

b. Water circulated

c. Inspected for H2 S Gas

(1) Hydrogen sulfide GAs

(2) Produced by decoying organic material.

(3) DEADLY

(a) Explosive

(b) Poisonous

(c) Small amounts - rotten egg ordor

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(d) Large amounts- no odor (e) colorless	QUESTIONS	
III. SHOW SLIDE PRESENTATION FROM NAVAL SAFETY CENTER ON SCUBA ACCIDENTS.	QUESTIONS ON SLIDE PRESENTATION	

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NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022
Medical Deep Sea Diving Technician A-433-0020
Ship Salvage Diving Officer A-4N-0011
Deep Sea (HeO2) Diving Officer A-4N-0010

Security Clearance: Unclassified

Lesson Topic: 5.1, Mk V Deep Sea Diving System

5 Hours

INSTRUCTION MATERIALS:

U.S. Navy Diving Manual, Vol. I
Student Guides
Standard Classroom Equipment
Mk V Deep Sea Diving System:
- Helmet
- Non-Return Valve
- Air Control Valve
- Diving Dress
- Cutaway of Air Hose
- Cutaway of Lifeline
- Shoes
- Weight Belt

Mk V Deep Sea Diving System Chart
Film: KN9915A

TERMINAL OBJECTIVE

1. When the student completes this course he will be able to, given an illustration of the Mk V Deep Sea Diving System, label all major components correctly and explain the function of each.

ENABLING OBJECTIVES:

1. EXPLAIN, in writing, the function(s) of the major components of the Mk V Deep Sea Diving System, in terms of what they do for the system.

2. DESCRIBE, in writing, the functional and physical location of each of the major components of the Mk V Deep Sea Diving System.

3. LIST, in writing, the protective devices for the major components of the Mk V Deep Sea Diving System.

4. DESCRIBE, through illustration, the flow path of the breathing media through the Mk V Deep Sea Diving System.

5. Orally DESCRIBE the three types of surface supplied diving rigs.

6. Orally EXPLAIN the application of the Mk V Deep Sea Diving System.

7. STATE, in writing, the minimum number of personnel necessary to dive the Mk V Deep Sea Diving System.

ENABLING OBJECTIVES (cont'd)

8. LIST, in writing, the advantages and disadvantages of the Mk V Deep Sea Diving System.

9. STATE, orally, the maximum and working depths for the Mk V Deep Sea Diving System.

10. STATE, in writing, the methods of communication used with the Mk V Deep Sea Diving System.

CRITERION TEST

Given an illustration of the Mk V Deep Sea Diving System, label all major components correctly and explain the function of each without error.

HOMEWORK

U.S. Navy Diving Manual, Vol. I, Chap. 1 and Chap. 6, para. 6.1.1

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction		
A. Establish Contact	Introduce self and topic	
B. Establish Readiness	Get students ready to learn	
C. Establish Effect	Bring out the need and value of material	
D. Overview	State Learning Objectives	
II. Presentation		
A. Types of Surface Supplied Diving Rigs	Show pictures, illustrations of each	Observe and take notes as necessary
1. Mk V Deep Sea Diving System		
2. Lightweight		
3. Mk V Mod I (HeO2)		
4. Surface Supplied means - breathing media is supplied to the diver by means of a hose from the surface.	Point out	
B. Flow path of breathing media	Diagram on C/B or use chart	
1. Low Pressure Air Compressor -		
a. Through a filter - remove impurities to the -		
b. Volume tank - air is cooled and stowed until needed - through a		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
c. Luffer sponge filter into the hose to the diver.		
2. High Pressure Air Compressor - through a reducer to a low pressure volume tank.	Diagram on C/B or use chart	
3. Diving Air must meet:	List on C/B; Explain terminology	
a. Established Standards of Purity - filtered		
b. Adequate volume		
c. Adequate flow rate (cfm)		
(1) Proper ventilation of helmet or mask.		
d. Overbottom pressure		
(1) Up to 120 ft - 50 lbs over		
(2) Over 120 ft - 100 lbs over		
e. Back up System		
C. Application of the Mk V Deep Sea Diving System		
1. Operations in deep water		
a. Normal working depth - 190' for 40 minutes		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
b. Maximum working depth - 250 ft for 90 minutes (exceptional exposure)	Emphasize	
2. High degree of protection and stability		
a. Heavy Salvage work		
b. Underwater Construction		
D. Advantages	List on C/B	
1. Unlimited Air Supply		
2. Maximum physical and thermal protection		
3. Voice and line-pull communications		
4. Work in current up to 2.5 knots		
5. Variable buoyancy		
E. Disadvantages	List on C/B	
1. Slow deployment		
2. Poor mobility		
3. Large Surface Craft and crew requirement		
a. Minimum 6 personnel		
4. Cumbersome (190 lbs)		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
F. Major Components of the Mk V Deep Sea Diving System		
1. Umbilical		
a. Hose	Show Air Hose Cutaway	
(1) Provides surface supplied air to diver.		
(2) Fittings on the hose are secured with three (3) hose clamps. Tested at regular intervals. No strain on hose.	Emphasize: No strain	
(a) Fittings are 17 threads per inch.		
(3) End is secured to diver's breastplate with line.		
(4) 50' length 1 1/16" outside diameter, 1/2" inside diameter.		
(5) Made of sinking type, vulcanized rubber tube reinforced.		
b. Lifeline and Amplifier Cable	Show cutaway of lifeline	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(1) Provides safety to diver		
(a) means of pulling diver up.		
(b) Communications between topside and diver		
(2) Runs from surface to diver's breast-plate where it is secured with a line and connected to left goose-neck of helmet.	Show on chart	
(a) Takes the strain off air hose		
(b) Tied (married) to air hose	Explain term "married" in relation to air hose/ lifeline	
(3) Breaking Strain 2500 lbs and with coupling installed 1[illegible]0 lbs.		
(4) Core consists of 3/16" corrosive resisting steel cable coated with high grade rubber cover.		
(a) 4 electrical wires for communi-cation.		
(b) Cover is oil resistent neoprene		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(5) 200' and 600' lengths.		
2. Air Control Valve	Show Air Control Valve	
a. Function		
(1) Provides a manual means for diver to control air into the helmet at a rate he requires.		
(2) Turn toward diver - more air. Turn away from diver - less air.	Demonstrate	
b. Location - part of hose group	Show on chart	
(1) Above the hip on the left front of the diver.		
(2) Within easy reach of left hand.		
(3) Connected to end of air hose from the surface and the three foot end of hose to the helmet.	Show on chart	
(4) Secured to breastplate with flexible link on valve.		
c. Protection Devices		
(1) Hand wheel is provided with se-		

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curing nut with a cotter pin going through nut and valve stem. Show on Air Control Valve

(2) Securing bracket to hold packing nut in place.

(3) With valve all the way open, a minimum of two (2) threads will be engaged. Demonstrate

d. Material

(1) Bronze - because of use in salt water.

(2) Two male fittings for hose connectors.

3. Hose Leader

a. Function Show Hose Leader

(1) Provides a means of connecting the air supply from control valve to non-return valve on helmet.

b. Ratings

(1) 3' length, 1 1/16" outside diameter, 1/2" inside diameter.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
c. Material - same as 50' air hose.		
(1) sinking type		
(2) vulcanized rubber tubing reinforced.		
4. Non-Return Valve	Show Non-Return Valve	
a. Function and Protection Provided		
(1) Prevents loss of air from diving helmet and dress, in case of air supply loss or hose rupture.		
(2) Prevents possible fatal squeeze to the diver.		
(3) One way check valve for helmet.		
b. Location	Show on Chart	
(1) Attached to helmet gooseneck (air hose fitting)		
c. Two Types - bodies are made of brass. Female end has a leather washer.		
(1) Spring and Stem - leather wash-		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
er seat and a spring.	Show	
(2) Cartridge - has cartridge and "O" ring seal.	Show	
5. Helmet/Breastplate	Show helmet	
a. Function		
(1) Fits over diver's head to provide protection.		
(2) Air Supply enters through gooseneck on right back side of helmet and is circulated around diver's head.		
(3) Houses speaker for communication with topside - located upper left front of helmet.	Show on helmet	
(4) Secured to Breastplate by interrupted screw joint at base.	Show on helmet	
b. Protective Devices		
(1) Ports - 4 heat treated glass view ports.		

(a) Front port is on a hinge pin and can be opened. In closed position, it is secured with beveled wing nut.

1. Rubber gasket and knife edge forms water tight seal.

(b) Ports have tobin bronze guards to prevent breakage.

(2) Safety Lock (Dumbell) Show on helmet

(a) Prevents helmet from turning on breastplate and coming off.

(b) Located on back of helmet.

(c) Fits into recess on breastplate and locked into "down" position. Held closed by swing bale and cotter pin on breastplate. Demonstrate

6. Exhaust Valve

a. Function is to release excess air pressure

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
from the helmet and diving dress.		
b. Maintains at least 1/2 lb over bottom pressure in the suit when valve is opened 2 1/2 turns.	Demonstrate	
c. Hand wheel cannot be opened more than five (5) turns from closed position (safety).		
d. Provides a controlled one way check valve to expel air without allowing water to enter.		
e. Chin Button on inside is controlled by:		
(1) Using lips to pull in to retain air.	Demonstrate Emphasize: Never hold chin button with teeth	
(2) Using chin to push to expel air.		
f. Made of tobin bronze. Two (2) internal springs are brass.		
7. Supplementary Exhaust Valve (Spitcock)	Show on helmet	
a. Function		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(1) Minor Buoyancy corrections	Explain	
(2) Auxiliary exhaust when the diver is working on his right side.	Explain	
(3) Expulsion of water collecting in the bib of the diving dress.	Explain	
b. Located on lower left front of helmet.	Show on helmet	
c. Is a 1/4 turn lever type.		
d. Open while diver is on the surface.		
8. Breastplate	Show breastplate	
a. Secures helmet group to diving dress.		
(1) Fits over diver's head and rests on shoulders.		
(2) Helmet is screwed on and form a watertight seal by a leather gasket recessed in top of the breastplate.	Show	
b. Two (2) Padeyes are located on front with signal halyard through each.	Show	
(1) Air hose is secured on left.		

(2) Lifeline/Amplifier Cable is secured on right.

c. 12 - 1/2" studs evenly spaced around breastplate to accept the rubber collar of the Mk V Diving Dress. Show

(1) Four (4) bronze straps (2 front, 2 back) are used to make a water-tight seal between the breastplate and the diving dress. Demonstrate

(a) Serialized - not interchangeable with other breastplates. EMPHASIZE

(2) Wing Nuts - 12 each, bronze Show

(a) Four (4) flanged wing nuts are used at breastplate strap joints.

(b) Eight (8) regular wing nuts are used. One on Bastard Stud is used to secure flexible link of Air Control Valve to breastplate. Show Bastard Stud. Explain

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

d. Material

(1) Helmet and Breastplate made of spun copper and tinned.

(2) Fittings made of tobin bronze (gunmetal).

(a) Non-corrosive metal

(b) All fittings are soft soldered to the helmet.

9. Mk V Deep Sea Diving System Dress — Show dress (or picture)

a. Function - provides a dry working environment and protection from underwater objects. Used with diving underwear, provides protection from cold.

b. Reinforced at specific areas of stress. Point out

(1) Crotch

(2) Knees

(3) Elbows

(4) Toes

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
c. Comes in three (3) sizes - marked by the number of gromets located in the back part of the bib. (1) No. 1 - small (one gromet) - for divers 5'7" - 5'9". (2) No. 2 - medium (two gromets) - for divers 5'9" - 5'11". (3) No. 3 - large (three gromets) - for divers 5'11" and up.	Point out location of gromets	
d. Have either cuffs or gloves cemented to dress. Dress, with gloves, is held to diver's wrist by straps. (1) Decreases air in the glove - easier to work.	Show gloves and wrist straps	
e. Top of dress has a rubber collar sewn and cemented in. Fitted with holes to accept the breastplate studs. Provides a watertight seal between dress and helmet.	Point out collar	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
f. Bib is to catch small amounts of water and to allow it to be expelled through the Supplementary Exhaust Valve.	Show Bib	:
g. Lacing Flaps are located on the back side of leg to prevent accumulation of air in lower part of dress. (1) Always laced with rawhide prior to entry into the water.	Show flaps and laces	
h. Dress is made of vulcanized sheet rubber between cotton layers. (1) Waterproof (2) Strong (3) Relatively Lightweight.		
10. Weight Belt - 84 lbs, Ten 7 1/2 lb lead weights	Show weight belt	
a. Provides negative buoyancy.		
b. Worn low around waist.	Show optimum position.	
c. Held in place by shoulder straps and jock strap.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(1) Jock Strap is to hold weight belt down on the diver's shoulders, thus holding helmet down.	Point out Jock Strap. Emphasize importance by example.	
(2) Jock Strap is a separate piece of equipment from the weight belt. Tested each day before use by applying a strain of at least 160 lbs.	Emphasize importance of testing before diving.	
d. Weight Belt is made of double water-proofed leather.		
(1) Belt and Jock Strap must be wiped down after each day's diving with Neets Foot Oil to preserve leather.		
11. Shoes	Show shoes or cutaway of shoes	
a. Provide negative buoyancy and assist in preventing diver's feet from raising higher than his head.		
b. One size only - 35 lbs per pair		
c. Cast bronze safety toe, lead bottom	Point out items as discussed	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
sole, wooden inner sole, steer hide tops.		
III. Summary a. Umbilical b. Air Control Valve c. Hose Leader d. Non-Return Valve e. Helmet/Breastplate (1) Ports (2) Exhaust Valve (3) Safety Lock (4) Supplementary Exhaust Valve (5) Breastplate f. Dress g. Weight Belt and Jock Strap h. Shoes	Using chart, or diver mock up (Jake), ask student to locate and tell function of each.	Respond to questions.
	Answer questions as necessary. Show film KN9915A - Mk V Diving System	Ask questions as necessary.

MK V DEEP SEA DIVING SYSTEM

UMBILICAL

HOSE LEADER

NON-RETURN VALVE

HELMET

AIR CONTROL VALVE

EXHAUST VALVE

DRESS

WEIGHT BELT

SUPPLEMENTARY EXHAUST (SPIT COCK)

SHOES

Identify the above listed major components of the Mk V Deep Sea Diving System by drawing an arrow from the name of the component to the appropriate picture of the component.

GPO 901-258

NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022
Medical Deep Sea Diving Technician A-433-0020
Ship Salvage Diving Officer A-4N-0011
Deep Sea (HeO2) Diving Officer A-4N-0010

Security Clearance: Unclassified

Lesson Topic: 5.2 Mk V Deep Sea Diving System Diver

11 Hours

Instructional Materials:

U.S. Navy Diving Manual, Vol. I
Student Guides
Standard Classroom Equipment
Diving underwear
Mk V Deep Sea Diving System W/gloves
Pipe square and wrench
Single Flange and wrench
Open tank
Film #KN9915 C

TERMINAL OBJECTIVES:

1. When the student completes this course he will be able to, as a diver using the Mk V Deep Sea Diving System in an open tank with a minimum of eight feet of water.

   a. Demonstrate an ability to use the Mk V Deep Sea Diving System in the underwater enviornment.

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TERMINAL OBJECTIVES (cont'd)

   b. Demonstrate all line-pull signals except those used in searching.

ENABLING OBJECTIVES:

1. DESCRIBE, orally, the application of equipment associated with the Mk V Deep Sea Diving System.

2. Orally, DEFINE the terms ventilate and circulate.

3. Orally STATE the safety precautions associated with the Mk V Deep Sea Diving Systems.

4. LIST, in writing, all line-pull signals (except searching) and EXPLAIN the use of each signal.

5. USE the proper line-pull signals in all training dives.

6. In an open tank, at a depth of at least eight feet, using the Mk V Deep Sea Diving System, PERFORM functions/actions comprising the Mk V Orientation Dive (as described in Diving Training Standards) as directed by the instructor through the phone talker.

7. In an open tank, at a depth of at least eight feet, using the Mk V

ENABLING OBJECTIVES (cont'd)

Deep Sea Diving System, COMPLETE the pipe square project in accordance with Diving Training Standards.

8. In an open tank, at a depth of at least eight feet, using the Mk V Deep Sea Diving System, COMPLETE the Single Flange Project in accordance with Diving Training Standards.

CRITERION TEST:

1. As a diver, using the Mk V Deep Sea Diving System in an open tank with a minimum of eight feet of water:

   a. Demonstrate an ability to use the Mk V Deep Sea Diving System in the underwater enviornment.

   b. Demonstrate all line-pull signals except those used in searching.

HOMEWORK:

U.S. Navy Diving Manual, Vol. 1, para 6.1.3, 6.4.3, 6.4.4, 6.4.5, 6.4.9.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction		
A. Establish Contact	Introduce self and topic	
B. Establish Readiness	Get students ready to learn	
C. Establish Effect	Bring out need and value of material. State information necessary to guide student conduct during class.	
D. Overview	State Learning Objectives	
II. Presentation		
A. Equipment associated with Mk V Deep Sea Diving System		Observe and take notes as necessary.
1. Descending Line	Show actual equipment, transparency or use C/B	
a. 3" manila rope		
(1) Left lain cable - prevents diver from spiraling around descent line.		
b. Used to guide diver to bottom/surface and to pass equipment.		
c. May be tied to underwater object or weight.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. Distance Line a. 60' of 15 thread. b. Tied to bottom end of descending line. c. Used for searching and finding descent line.	Show actual equipment, transparency or use C/B	
3. Stage a. Used to put divers in the water or bring them out.	Show picture or draw on C/B	
4. Stage Line a. 3" or 4" manila or nylon. b. Marked at 10' intervals. c. Used to raise/lower decompression stage.	Fxplain	
5. Diving Ladder a. Used when entering/exiting water along side a small boat. b. Made of galvanized steel.	Show picture or draw on C/B	
6. Descending Weights a. Placed on bottom of descent line to hold it in place.	Show picture or draw on C/B	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
b. 50 and 100 lb cast iron.		
7. Underwater lights	Show equipment, transparency or picture.	
a. May increase range of vision.		
b. Hand held, battery operated.		
(1) Medium pressure up to 150'		
c. Electric		
(1)150' - 100 watt photo bulb		
(2) 500' - 1000 watt photo bulb		
d. Lights must be turned on and off underwater because of thermal shock to bulb.	Emphasize	
8. Tool Bag	Show equipment	
a. Made of canvas with drain holes.		
b. Looped over diver's arm or sent down descent line.		
9. Air Wrenches	Show equipment	
a. 1 3/8 open end		
b. 2 required		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
c. Used to connect diver's air control valve and non-return valves.		
10. Telephone Wrench a. 2" open end wrench b. Connects telephone/amplifier to helmet gooseneck.	Show Telephone Wrench	
11. Horsecollar a. Cushion for breastplate b. Fits over diver's head c. Helps prevent calcium deposits on shoulders.	Show Horsecollar	
	Show film #KN9915C (Use of the Mk V Deep Sea Diving System)	
B. Ventilate/Circulate		
1. Ventilate - allows fresh supply of air into dress. a. Open air control valve and depress chin button.	Emphasize: More air away from me, Less air to me.	
2. Circulate - return to normal flow.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
3. When used:		
a. When diver first reaches the bottom.		
b. At intervals during work.		
c. In the event of a CO2 buildup.		
d. Normally directed from topside, but taken as needed.	Diver should inform topside.	
C. Safety Precautions		
1. Must have a standby diver dressed topside and ready to go.	Emphasize: Standby diver should have similar capabilities.	
2. If diving 170' and over, must have a chamber and Diving Medical Officer available.		
3. Take air samples quarterly.		
4. Backup air system		
5. Do not dive a man who does not feel well.	Give examples.	
6. Plan the dive thoroughly.		
7. Must have adequate air supply for depth of dive.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
D. Projects		
1. Using Diving Training Standards, explain each project to be completed.	Encourage students to look at projects on the surface - try them, if possible.	Questions as necessary

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SWIMMER TRAINING AND QUALIFICATIONS

Extracted from Bureau of Naval Personnel Manual

1. Naval activities engaged in qualifying swimmers shall utilize the current edition of American Red Cross Swimming and Water Safety Manual as the authoritative text for the swimming procedures, strokes, breaks, holds, etc., described in this article.

2. To qualify as a swimmer, third class, a member must enter the water feet first from a minimum height of five feet and remain afloat for five minutes. During this time he must swim 50 yards using any stroke or combination of strokes. This test should be taken by all members as early as possible in their training period. Those who are able to enter the water as prescribed and float for five minutes, but are unable to swim the required 50 yards will be classified as swimmer, fourth class and should be given instruction in fundamental swimming skills with a view to achieving a swimmer, third class qualification as soon as practicable. In every case, a swimmer, fourth class is a "swimmer who needs help" and should continue to receive additional instruction in fundamental skills. Such members should not be recycled or held back in their training schedule for this reason alone. Those members who are unable to enter the water as prescribed and/or are unable to float for five minutes are to be classified as non-swimmers and shall be given instruction in fundamental swimming skills with a view to achieving designation as a swimmer, fourth class thus meeting the minimum water survival qualification for service in the Navy. The test for swimmer, third class is the official Navy Standard Basic Swimming Test. While the minimum swimming qualification is swimmer, fourth class, the attainment of swimmer, third class designation at the earliest practicable time remains a firm basic goal for all members who have not attained that level of swimming proficiency.

(a)

3. A prerequisite to qualification as swimmer, second class, is successful completion of test for swimmer, third class. To qualify as a swimmer, second class, a member must enter the water feet first from a minimum height of 10 feet and remain afloat for 10 minutes. During this time he must swimm 100 yards and use the three basic survival strokes (side stroke, back stroke, and breast stroke) for a minimum distance of 25 yards each. This swimmer is classified as one who can "take care of himself" without assistance in a swimming survival situation.

4. A prerequisite to qualification as swimmer, first class, is successful completion of test for swimmer, second class. To qualify as a swimmer, first class, a member must be able to do each of the following.

a. Approach a person of approximately his own size while in the water, demonstrate one break or release, get him in a carry position, and tow him 25 yards.
b. Enter water feet first and immediately swim under water for 25 yards.

Swimmer is to break the surface twice for breathing during this distance at intervals of approximately 25 feet. This requirement simulates abandoning ship. Jumping from excessive height is discouraged.

c. Remove trousers in water, inflate for support and remain motionless for a minimum of one minute.
d. Swim 220 yards using any survival stroke or combination of survival strokes desired. This swimmer is classified as one who not only can "take care of himself" without assistance in a swimming survival situation, but is able "to help others" in case of emergency.

5. Make entry of swimmer qualifications of Page 3 of the service record.

(4)

DIVING TRAINING STANDARDS

UNIT: 1. Orientation

2. Underwater Basic

DIVING COMMUNICATIONS STANDARDS

Following are standards to be used when grading, observing, and/or teaching Diving Communications.

LINE-PULL SIGNALS

1. In accordance with the U.S. Navy Diving Manual, line-pull signals should be:
   a. Sharp, distinct pulls.
   b. Strong enough to be felt by the diver.
   c. Not so strong as to pull the diver away from his work.
   d. Given after all slack has been taken from the line.

NOTE: If the instructor is in doubt as to whether or not tenders are giving proper line-pull signals (as above), place your hand on the line and check for slack, distinctness, etc.

VOICE COMMUNICATIONS

(11)

As a Phone Talker:

1. Color code first at all times with the exception of telling the diver to circulate.
   EXAMPLE: "Red Diver. Coming to your first stop."
   EXAMPLE: "Circulate, Red, Circulate."
2. Insure that the diver repeats the given order verbatim to the phone talker. Repeat the order if not given back verbatim.
3. Repeat, to the diver, any communication from the diver, verbatim.
4. Speak slowly and distinctly. Lower the normal pitch of the voices.
5. Keep conversations brief and simple.
6. Avoid other radio terminology (i.e. Roger, Over and Out, Wilco, etc.).
7. No profanity.

As a Diver

1. Relay information to topside on status of diver and/or task when change occurs.
2. Communications initiated by the diver begins with "Topside, this is (color code)."
   EXAMPLE: "Topside, this is Red Diver - on the bottom."

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3. Repeat orders given by topside, verbatim.
4. Speak slowly and distinctly. Lower the normal pitch of your voice.
5. Keep conversations brief and simple.
6. Avoid other radio terminology (Roger, Over and Out, Wilco etc.).
7. No profanity.

(12)

DIVING TRAINING STANDARDS

TASK: Familiarization Dive

UNIT: 1. Orientation

GENERAL DESCRIPTION: Diver descends to bottom of the open tank and completes various maneuvers in accordance with directions from the instructor.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Tank		
2. DEPTH	at least 8 feet		
3. EQUIPMENT	Mk V System		
4. OTHER	NONE		

STANDARDS:

1. PERFORMANCE	1. Without difficulty 2. Good use of line-pull signals		
2. TIME	NONE		
3. EQUIPMENT	NONE		

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PROCEDURES:

1. Primary
   a. Diver enters the water using the ladder.
   b. Diver closes Supplementary Exhaust Valve before descent.
   c. Diver reports leaving the surface and arrival on bottom.
      (1) Line-pull signals.
      (2) Voice Communications
   d. Ventilate Diver.
   e. Circulate Diver.
   f. Have diver stand in center of open tank facing Red Port.

2. System Checkout: Have diver
   a. Open Supplementary Exhaust Valve (wait approximately ten seconds).
   b. Close Supplementary Exhaust Valve.
   c. Secure Air Control Valve.
   d. Open Air Control Valve.
   e. Lie down on back, stomach, and on right side (in order).
      (1) While on right side, have the diver open and close Supplementary Exhaust Valve.
   f. Crawl around open tank twice.
   g. Lie down in center of tank, pull in chin button and come to a standing position without using hands.
   h. Make a controlled ascent.
      (1) Pull in chin button.
      (2) Increase air with Air Control Valve
      (3) Break surface with helmet and remain in a vertical position for 30 seconds.
   i. Secure from System Checkout.

3. Communications Checkout
   a. Have diver initiate/respond to the following line-pull signals:
      (1) 2-1 (I understand/answer the telephone)
      (2) 3-2 (More air)
      (3) 4-3 (Less air)
      (4) All emergency signals.
   b. Have diver give proper line-pull signals and come to surface.
      (1) Close Supplementary Exhaust Valve on surface and proceed up the ladder.

(14)

WHY DO IT:

To familiarize students with the Mk V Deep Sea Diving System, the effects of water pressure on the body, and use of line-pull signals.

SKILLS NEEDED:

None

SPECIAL INSTRUCTIONS:

None

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PROCEDURES:

1. Disassembling
   a. Descend project to bottom.
   b. Diver removes nuts, bolts and gasket.
      (1) Put nuts and bolts in tool bag.
   c. Use line-pull signals and send for square mark.
   d. Secure gasket to square mark and send it topside.
   e. Recover gasket from topside.
2. Reassembling
   a. Reassemble flange in reverse order making sure bench marks are alined and gasket is in place.

WHY DO IT:

To acquaint the student with minor jobs underwater and the requirement for a water tight flange fitting.

SKILLS NEEDED:

Basic mechanical

Be able to overcome the restrictions created by the Mk V and SCUBA systems.

SPECIAL INSTRUCTIONS:

1. Time is to start when diver reports he in on the bottom and has located project.
2. Time is to be stopped when diver calls for project to be hauled topside.
3. Instructor must insist on use of proper line-pull signals and voice communications throughout all training dives.

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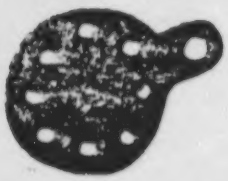
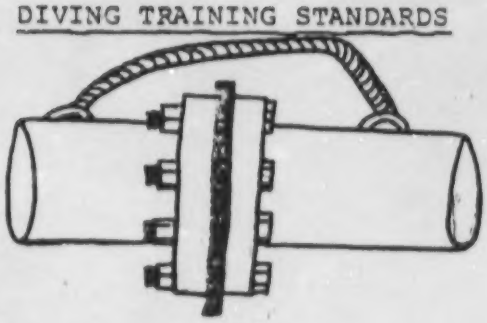
DIVING TRAINING STANDARDS

TASK: Single Flange





UNIT: 1. Orientation
2. Underwater Basic
3. SCUBA

GENERAL DESCRIPTION: Diver descends to bottom of open tank/open water, disassemble and reassemble, with gasket, the single flange project.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Tank	Open Water	Open Water
2. DEPTH	at least 8 feet	at least 20 feet	at least 20 feet
3. EQUIPMENT	Mk V System Tool Bag 2 open-end wrenches	Mk V System Tool Bag 2 open-end wrenches	SCUBA gear and wet suit Tool Bag and 2 open-end wrenches
4. OTHER	NONE	Murky water or faceplate blacked out	NONE

STANDARDS:

1. PERFORMANCE	Use proper line-pull signals	Use proper line-pull signals	NONE
2. TIME	60 Minutes	60 Minutes	30 Minutes
3. EQUIPMENT	1. Bench marks alined. 2. At least 6 nuts and bolts wrench tight	1. Bench marks alined. 2. At least 6 nuts and bolts wrench tight.	1. Bench marks alined. 2. At least 6 nuts and bolts wrench tight

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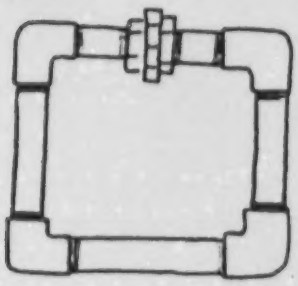
DIVING TRAINING STANDARDS

TASK: Pipe Square

UNIT: 1. Orientation



GENERAL DESCRIPTION: Diver takes pieces of pipe square in tool bag to the bottom of the open tank and assembles the square.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Tank		
2. DEPTH	at least 8 feet		
3. EQUIPMENT	Mk V System Tool Bag		
4. OTHER	NONE		

STANDARDS:

1. PERFORMANCE	Use proper line-pull signals		
2. TIME	15 Minutes		
3. EQUIPMENT	Hand tight		

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PROCEDURES:

1. Place three long pipes along side each other on the deck.
2. Place four elbows in similar area.
3. Hold one long pipe and secure one elbow to each end and then back the elbows off one complete turn.
4. Screw remaining long pipes (2) into secured elbows.
5. Secure the remaining elbows (2) to the two pipes, being sure that elbow openings are lined up.
6. Remove short pipe from tool bag and screw into open elbows.
7. Screw union end on one short pipe.
8. Place union ring on remaining short pipe with threads facing the center of the joint.
9. Screw tail piece onto same pipe as union ring with seat facing joint.
10. Screw union ring onto union end of opposite pipe.

WHY DO IT:

To acquaint the student with minor jobs in the underwater environment so that he develops an appreciation for working in the Mk V Deep Sea Diving System.

SKILLS NEEDED:

Basic Mechanical Skills

SPECIAL INSTRUCTIONS:

1. Time starts when diver removes the first piece of pipe from the tool bag.
2. Time stops when diver reports the project complete.
3. Instructors must insist that proper line-pull signals and voice communications be used at all times.

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NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022
Medical Deep Sea Diving Technician A-433-0020
Ship Salvage Diving Officer A-4N-0011
Deep Sea (HeO2) Diving Officer A-4N-0010

Security Clearance: Unclassified

Lesson Topic: 5.3 Mk V Deep Sea Diving System Tender

13 Hours

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual, Vol. 1
Student Guides
Standard Classroom Equipment
Practice line
Film #KN9915B
2 Mk V Deep Sea Diving Systems
Diving Telephone System
Diving Log
OPNAV Form 9940-1
Exhaust Valve Cutaway
Non-Return Valve Cutaway
Diving Underwear

TERMINAL OBJECTIVES:

1. When the student completes this course, he will be able to, as a member of a team tending a diver using a Mk V Deep Sea Diving System in an open tank:

   a. demonstrate all tender-to-diver line-pull signals (except searching).

   b. dress a diver in a Mk V Deep Sea Diving System, withing 15 minutes, so that he may safely enter the water.

   c. demonstrate proper telephone communication procedures and phraseology, in accordance with Diving Training Standards, under instructor guidance.

   d. demonstrate proper inspection procedures for exhaust and non-return valves to insure safe operation.

   e. demonstrate maintenance of the diving log (including OPNAV Form 9940-1) under instructor guidance.

ENABLING OBJECTIVES:

1. LIST, in writing, all line-pull signals (except searching).

2. EXPLAIN, in writing, the use of all line-pull signals (except searching)

3. EXPLAIN, orally, proper phraseology of voice communication used when diving.

4. EXPLAIN, orally, proper operation of

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ENABLING OBJECTIVES (cont'd)

of the diving telephone used for voice communication when diving.

5. Orally EXPLAIN the proper procedures for dressing a diver in a Mk V Deep Sea Diving System so that he may safely enter the water.

6. As a member of a team of two tenders, PRACTICE dressing a diver in a Mk V Deep Sea Diving System.

7. Orally EXPLAIN the inspection procedures for the exhaust and non-return valves on the Mk V Deep Sea Diving System including the importance of the operation and frequency.

8. PRACTICE the operation of the telephone used in voice communication during diving operation. PRACTICE proper phraseology.

9. PRACTICE, under instructor guidance, inspecting the exhaust and non-return valves on the Mk V Deep Sea Diving System.

10. Orally EXPLAIN the reason for maintaining a log of diving operations (including OPNAV Form 9940-1).

11. Orally EXPLAIN the procedures for completing the log containing information on diving activities, (including OPNAV Form 9940-1).

ENABLING OBJECTIVES (cont'd)

12. PRACTICE, under instructor guidance, entering information in a typical diving log and OPNAV Form 9940-1.

CRITERION TEST

1. As a member of a team tending a diver using a Mk V Deep Sea Diving System in an open tank:
   a. demonstrate all tender-to-tender line-pull signals (except searching) during diving training activities, without error.
   b. dress a diver in a Mk V Deep Sea Diving System, within 15 minutes, so that he may safely enter the water.
   c. demonstrate proper telephone communication procedures and phraseology, in accordance with Diving Training Standards, under instructor guidance.
   d. demonstrate proper inspection procedures for exhaust and non-return valves to insure safe diving operations.
   e. demonstrate maintenance of the diving log (including OPNAV Form 9940-1) under instructor guidance.

HOMEWORK

U.S. Navy Diving Manual, Vol 1, Table 6-3 para 6.3, Figure 6-36, Appendix B., para 6.4.8

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction		
A. Establish Contact	Introduce self and topic.	
B. Establish Readiness	Get students ready to learn	
C. Establish Effect	Bring out need and value of material being presented. State information necessary to guide student conduct during class.	
D. Overview	State Learning Objectives	
II. Presentation		
A. Diving Logs and OPNAV Form 9940-1	Show Green Log Books and OPNAV Form 9940-1	
1. During this first week instructors will instruct you on station on filling out the diving log. You will enter the information in the log as you are instructed. During Underwater Basic, you will receive classroom instruction on the diving log and OPNAV Form 9940-1. You will be responsible for filling both out from that time on.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
B. Communications		Take notes as necessary.
1. Voice Communications: Primary means of communications for Mk V Deep Sea Diving System.		
a. Through cone type loudspeaker mounted in the Mk V Helmet, connected electrically through the diving cable, to an amplifier topside.		
2. Phraseology is important.		
a. During Orientation, Phone Talker will be told by the instructor what to say to the diver. DO NOT DEVIATE. REPEAT VERBATIM.	Emphasize.	
b. Diver should also repeat verbatim any communication received from phone talker. Shows understanding.	Emphasize.	
3. Guidelines		
a. Topside		
(1) Use color code first except to		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
tell diver to "circulate".	Example: "Red Diver, Begin Project"; or "Circulate, Red, Cirulate".	
(2) Insist that diver repeats order verbatim.		
(3) No profanity.	Emphasize	
(4) Repeat any conversation from the diver verbatim.		
b. Diver		
(1) Always identify yourself.	Example: "Topside, Red Diver beginning project"	
(2) Repeat orders received from the Phone Talker verbatim.	Example: "Circulate, Red, Circulate".	
(3) Keep conversation to a minimum.		
(4) No Profanity	Emphasize	
c. DO NOT use standard radio terminology (i.e., Roger, Over-and-Out, etc.)		
4. Line-Pull Communications: Back up for phone in use of Mk V Deep Sea Diving System.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
a. Given by tender or diver by pulling on the umbilical or other designated line.	Example: Tether line when using SCUBA.	
b. Used at all times even though voice communications are available.	Emphasize	
c. Standard Signals	Demonstrate as discussed	Observe and ask questions as necessary.
(1) From Tender to Diver		
(a) 1 Pull - "Are you all right?"		
(b) 2 Pulls - "Going Down" During ascent, 2 pulls mean you have come up too far; go back down until we stop you.		
(c) 3 Pulls - "Standby to come up"		
(d) 4 Pulls - "Come up"		
(e) 2-1 Pulls - "I understand", or "Answer the telephone"		

(2) From Diver to Tender

(a) 1 Pull - "I am all right", or, during descent, "I am on the bottom"

(b) 2 Pulls - "Lower", or "Give me slack"

(c) 3 Pulls - "Take up my slack"

(d) 4 Pulls - "Haul me up"

(e) 2-1 Pulls - "I understand", or "Answer the telephone"

(f) 3-2 Pulls - "More air" By tender - ventilate

(g) 4-3 Pulls - "Less air" By tender - circulate

(3) Emergency Signals

(a) 2-2-2 Pulls - "I am fouled and need the assistance of another diver"

(b) 3-3-3 Pulls - "I am fouled but can clear myself"

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(c) 4-4-4 Pulls - "Haul me up immediately"

ALL SIGNALS WILL BE ANSWERED AS GIVEN EXCEPT FOR EMERGENCY SIGNAL 4-4-4.

(4) Special signals from the diver:

(a) 1-2-3 Pulls - "Send me a square-mark"

(b) 5 Pulls - "Send me a line"

(c) 2-1-2 Pulls - "Send me a slate"

(5) Standards for use and grading line- pull signals (from Diving Training Standards) Demonstrate

(a) Tender

1. Sharp, distinct pulls.
2. Strong enough to be felt by the diver.
3. Not strong enough to pull diver away from work.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
4. Given after all slack has been taken from line.		
(b) Diver		
1. Correctness		
2. Sharp, distinct pulls.		
3. Strong enough to be felt by tender.		
(6) Practice.	Pair up students with short piece of line between them. Designate one as the diver and one as the tender. Practice line-pull signals one at a time.	Respond to directions by instructor. Practice line-pull signals using knowledge and standards learned.
C. Valve Inspections	Demonstrate	Observe and ask questions as necessary.
1. Exhaust Valve		
a. Set each dive.		
b. Correct setting is 2 1/2 turns from fully closed.		
c. Check chin button for excessive play.		
d. Tell diver prior to closing faceplate that the Exhaust Valve is set.	Demonstrate	

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. Non-Return Valve		
a. Checked before each day's diving activity.		
(1) Smoke Test - Blow cigarette smoke through female end. Look for escaping smoke through male end.	Demonstrate	
(2) Low Pressure Air Test - use 1/2 to 3/4 lb of air pressure through female end of the valve and place in a bucket of water. Check for escaping bubbles through male end.	Demonstrate	
	Show film*KN9915R (Tender's duties and dressing procedures)	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
D. Dressing Procedures	Instructors demonstrate using student as diver	Observe and ask questions as necessary
1. Begin with diver wearing diving underwear and socks.		
2. Put on diving dress.		
3. Lace flaps on back of legs.	Emphasize: Not too tight to cut circulation. Stow ends after tying.	
4. Tenders assist diver with shoes. Diver sits down on bench. Tenders lace, tie and buckle shoes.	Tie with square knot. Stow ends under leather straps. Buckles to outside.	
5. Position breastplate between bib and rubber gasket. Place brass shims on studs where brales join.	Stow lanyards out of the way behind the diver's neck.	
6. Place the four breastplate straps (brales) over the breastplate studs. Install lug nuts hand tight on all studs.	Insure brales are properly located. Emphasize: NOT INTERCHANGEABLE. Lug nuts with flange at brale joints.	
7. Using socket wrench, tighten all lug nuts. Use alternate tightening sequence. Remove lug nut from bastard stud and place it (hand tight) on stud above.	Tenders keep hand between breastplate and diver while tightening. Insure that rib of rubber gasket is outside the brales.	

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
8. Place wrist straps on diver's wrists.	Insure correct position of shoulder straps. Insure jock strap is positioned before buckling.	
9. With diver sitting, tenders position weight belt. Buckle straps in back.		
10. Diver stands, placing hand over bastard stud. Tender behind feeds jock strap through the diver's legs to front tender. Diver bends forward for buckling of jock strap.	Jock Strap should not be too tight (voice change) or too loose - able to lift helmet a good distance off shoulders.	
11. Diver sits on bench. One tender steadies diver while other tender places helmet in position.	Put lanyards down on breastplate away from the collar. Insure faceplate is closed while putting helmet on. Lower over head carefully. Check alignment and insure proper seating of helmet.	
12. Back tender braces the diver while front tender turns the helmet into position.		
13. Back tender secures the safety lock.	Insure proper position of cotter pin.	
14. Front tender secures air control valve to bastard stud. Tighten	Insure correct positioning of air control valve.	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
lug nut with socket wrench.		
15. Secure lifeline/telephone cable and air hose to breastplate by tying off with lanyards.	Take two turns around cable and hose each direction from padeye and secure with a square knot.	
16. Set Exhaust Valve 2 1/2 turns from fully closed position. Open Supplementary Exhaust Valve.	Tell Diver	
17. Close faceplate and secure with swing nut.		
18. Front tender holds umbilical, rear tender holds helmet goosenecks. Pat diver two times on helmet - signal to stand up. Lead diver to ladder or stage.	Emphasize: Diver must NEVER be left unattended.	
19. Questions on procedures.		
20. Practice by students.	Group students in teams of three. All should get an opportunity to dress a diver. Instructor observe and correct as necessary.	Follow learned procedures to dress a diver in a Mk V Deep Sea Diving System.

NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022
Medical Deep Sea Diving Technician A-433-0020
Ship Salvage Diving Officer A-4N-0011
Deep Sea (HeO2) Diving Officer A-4N-0010

Security Clearance: Unclassified

Lesson Topic: 6.1 Mk V Deep Sea Diving System

5 Hours

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual, Volume I
Student Guides
Standard Classroom Equipment
Mk V Deep Sea Diving System:
- Helmet
- Non-Return Valve
- Air Control Valve
- Air Hose and Fittings
- Lifeline and Fittings
- Dress
- Weightbelt
- Shoes

TERMINAL OBJECTIVES

1. When the student completes this course he will be able to, given a list of Mk V Deep Sea Diving System component parts, demonstrate a knowledge of the function of each, by matching the component part with its functional description.

ENABLING OBJECTIVES

1. EXPLAIN, in writing, the function(s) of the component parts of the Mk V Deep Sea Diving System in terms of what they do for the system.

2. DESCRIBE, by illustrating, the functional and physical location of the component parts within the major components.

3. EXPLAIN, in writing, how the component parts carry out their function(s).

4. Orally DESCRIBE the major materials used to construct selected component parts and EXPLAIN why the particular material is used.

CRITERION TEST

Given a list of Mk V Deep Sea Diving System component parts, demonstrate a knowledge of the function of each, by matching the component part with its functional description.

HOMEWORK

Student Guide, Volume C, Information Sheets 6-1-1I through 6-1-4I
Assignment Sheets 6-1-1A and 6-1-2A

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction		
A. Establish Contact	Introduce self and topic.	
B. Establish Readiness	Get students ready to learn.	
C. Establish Effect	Bring out need and value of material being presented.	
D. Overview	State learning objectives.	
II. Presentation		
A. Umbilical	Use actual equipment cutaways, or charts to illustrate points.	Take notes as necessary.
1. Standard Deep Sea Hose--carries breathing media from supply to diver.		
a. Air Hose Fittings.		
1. Male/female to secure two lengths of hose or secure hose to helmet/air supply.		
2. Made of brass to prevent corrossion.		
b. Hose Washer--used when securing hoses together or to helmet for watertight seal.		

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1. Made of leather.
2. Check when setting up station.
3. Neets Foot Oil used to preserve washer and aid in making seal.

2. Lifeline/Telephone Cable--voice and line-pull communications.
   a. Secured to breastplate by lanyards. Demonstrate securing lifeline to breastplate.
3. Pneumohose--depth measuring device; records depth of diver. Show location. Explain effect of depth and pressure.
   a. 5/16 I.D. oxygen hose.
4. Seizing Stops--used to marry air hose, pneumohose and lifeline.
   a. Uses marlin every 4 feet.
5. Hose Cover--protects the first 50' of umbilical from chaffing and fouling.
   a. Made from #2 canvas sewn with herring bone stitch.

B. Air Control Valve

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
1. Hand Wheel	Use actual equipment, cutaway or chart to illustrate points.	Take notes as necessary.
a. Used to turn air on or off.		
b. Made of brass to prevent corrossion.		
2. Bracket.		
a. Secures cap nut in place.	Demonstrate	
b. Made of brass.		
3. Cap Nut		
a. Applies pressure on the stuffing box gland.		
b. Made of brass.		
4. Stuffing Box Gland		
a. Applies pressure on flax packing.		
b. Made of brass.		
5. Packing		
a. Form water/air tight seal.		
b. Made from 1/8' square flax.	Pass a piece of flax around class.	
7. Stuffing Box.		
a. Accepts packing.		
b. Made of lead--softer metal		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
conforms better to the stuffing box.		
9. Valve Stem		
a. Opens and closes air passages.		
10. Body		
a. Houses valve stem.		
b. Has air fittings for hose and hose leader.		
c. Has the padeye.		
11. Securing Padeye.	Demonstrate.	
a. Secures air control valve to breastplate at bastard stud.		
12. Valve Jamming		
a. Explanation of jamming open or or closed due to:	Demonstrate.	
1. Hitting the hand wheel.		
2. Icing.		
b. X-valve.		
1. Cannot be jammed.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
C. Hose Leader--carries breathing media from air control valve to helmet.	Use actual equipment cutaways, or charts to illustrate points.	
1. Standard Deep Sea Hose.		
a. 3 feet and 3 feet 9 inches in length		
b. Double female fittings.		
c. Leather hose washer at each end.	Emphasize. Check washers each diving day.	
D. Non-Return Valve prevents squeeze.	Use actual equipment cutaways or chart to illustrate points	Take notes as necessary.
1. Cartridge Types		
a. Body-houses cartridge; contains fittings for connecting to helmet and air hose leader.		
b. Valve Cartridge--holds O-ring in place to form non-return seal.		
c. O-Ring forms seal.		
2. Stem and Spring Type.		
a. Body--houses functional parts; contains fittings for connecting to helmet and air hose leader.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
b. Valve Guide--keeps valve in line.		
c. Stem Guide (upper)--keeps stem aligned.		
d. Spring--returns stem and valve to seat when air pressure decreases.		
e. Valve Stem--guides washer to seat.		
f. Stem Washer.		
1. Forms seal.		
2. Made of leather.		
g. Washer--forms seal.		
h. Locknut--keeps washer in position.		
i. Stem Guide (lower)--keeps stem in line.		
E. Helmet		
1. Body	Use actual equipment, cutaway or chart to illustrate point.	Take notes as necessary.
a. Protects the diver.		
b. Acts as compartment for breathing media.		
c. A body to attach other component parts.		

2. Swing Bolt and Wing Nut. Demonstrate.
   a. Secures face plate in place during a dive.
3. Faceplate.
   a. Allows diver to see out of front.
   b. Open while diver is being dressed/ undressed.
   c. Made of brass and heat treated glass.
4. Viewports.
   a. Allows diver to see out sides and top of helmet.
   b. Made of brass and heat treated glass.
   c. Guards (Made of brass).
      1. Help hold glass in place.
      2. Prevent accidental breakage.
5. Spit Cock (Supplementary Exhaust)
   a. Allows for fine adjustment in buoyancy.
   b. Allows diver to take in a small amount of water to spit on a fogging

faceplate.

c. Secondary exhaust when working on diver's right side.

d. Located on left side of helmet.

e. A lever which moves up (open) or down (closed).

f. Made of brass.

6. Helmet Locking Device (Dumbbell).

a. Placed in the down position and locked with cotter pin once helmet is in place on breastplate. Demonstrate.

b. Prevents helmet from turning free of breastplate.

c. Made of brass.

7. Air Hose Gooseneck.

a. Attachment for air hose.

b. Allows air to enter helmet.

8. Communication Gooseneck.

a. Attachment for lifeline/telephone cable.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
9. Transceiver Recess.		
a. Holds transceiver in a position where it does not bump diver's head.		
10. Exhaust Valve Body	Detailed explanation of the exhaust valve later in I.G.	
a. Holds exhaust valve.		
11. Zincs.		
a. Prevents corrossion of metal on helmet.	Explain how/why.	
b. Next to faceplate on left side.		
12. Air Deflector Channel		
a. Channels air over parts to prevent fogging and annoyance.	Show flow of air.	
13. Breastplate.		
a. Distributes weight of helmet over diver's shoulders and provides a means of a watertight seal between helmet and diving dress.		
1. Studs--serve to seal breastplate		

to diving dress.

(a) Made of brass.

Point out bastard stud and explain why it is longer.

2. Straps--fits over dress at the studs, for seal.

3. Washer--used at joint of straps.

(a) Prevents tearing of dress.

(b) Aids in providing an even seal.

(c) Made of copper-malable and corrosion resistent.

4. Gasket--keeps joint between helmet and breastplate watertight.

(a) Made of leather.

(b) Shims--may be needed to make minor height adjustments on gasket.

Emphasize that shims should only be used for used and worn gaskets.

(1) Made of chart paper.

5. Wing Nusts--assure a watertight seal.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
6. Eyelets--devices used to secure lanyards to breastplate.	Demonstrate.	
7. Lanyards--used to secure lifeline and air hose to breastplate. (a) Made of signal halyard. (b) 36" in length.		
14. Reproducer		
a. Provides two-way voice communication between diver and topside.	Use actual equipment, cutaways, or charts to illustrate points.	Take notes as necessary.
b. Located inside the helmet--upper left between top and left port.		
c. Speaker is made of fiber and a magnet to collect and transfer sound vibrations.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
15. Exhaust Valve a. Adjusting Hand wheel. 1. Adjusts pressure of air remaining in the system. 2. Located between and slightly below right port and faceplate. b. Secondary Spring 1. Safety valve for normal operations. 2. Begins to open at 2 pounds pressure. c. Secondary spring following disc. 1. Enables the secondary spring to be depressed when over 1/2 pounds of pressure is applied. d. Adjusting sleeve set screw. 1. Holds adjusting sleeve in proper alignment. e. Retainer Ring-prevents adjusting	Use actual equipment, cutaways, or charts to illustrate points.	Take notes as necessary.

hand wheel from unscrewing from exhaust valve bonnet. Demonstrate.

f. Bonnet.
   1. Inside threads for hand wheel.
   2. Prevents hand wheel from jamming when closed.

g. Bonnet Guard--secures bonnet in place.

h. Primary valve spring.
   1. Allows 1/2 psi to remain in dress.

i. Adjusting Sleeve--allows adjustment of primary spring.

j. Stem Valve Disc--acts as seat to valve body, keeping air in dress.

k. Valve Stem--carries the valve disc away from seat when springs are

depressed.

1. Chin Button. Demonstrate.

1. Allows diver to adjust buoyancy inside the helmet.

2. Helps prevent accidental blowups.

F. Diving Dress

1. Rubber Gasket -forms junction with breastplate. Use actual equipment, cutaway or slide.

2. Cuffs.

a. Made of rubber.

b. Provide a watertight seal around wrists.

3. Gloves.

a. Prevent injury and guard against cold.

4. Wrist Straps. CAUTION: Wrists straps cannot be too loose or too tight.

a. Used to:

(1) Prevent hands from slipping from gloves. EXPLAIN.

(2) Adjust length of sleeve.

(3) Can be used with cuffs to temporarily secure a pair of gloves.

b. Made of leather.

5. Laces.

a. Used to tie legs of dress to prevent excess air pockets.

b. Made of leather for strength and flexibility.

6. Grommets

a. Prevents laces from tearing dress.

b. Made of brass.

7. Body.

a. Protects diver.

b. Aid in forming watertight area for diver.

8. Chafing Patches--protects dress at critical areas.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
9. Bib.		
a. Serves to trap any water that may enter the helmet through the valves.	Explain how.	
G. Weight Belt.		
1. Belt--a means of placing weights around diver uniformly.	Use actual equipment, cutaways or charts to illustrate points.	
2. Weights.		
a. Provide negative buoyancy.		
b. 10 weights of 7 1/2 pounds each.		
3. Shoulder straps--prevents weight belt from shifting.		
4. Jockstrap.		
a. Prevents helmet and breastplate from rising off diver's shoulders.		
b. Made of leather for flexibility and durability.		
H. Utility Tool--used for prying, hacking,	Pass tool around.	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
sawing, or cutting.		
I. Shoes		
1. Lead Sole.	Use actual equipment, cutaway or charts to illustrate point.	
a. Overcome positive buoyancy.		
b. Aids diver in remaining upright.		
2. Hardwood Upper Sole--a means to secure lead sole to leather uppers.		
3. Uppers--a means to secure weight to diver's foot securely.		
4. Lacing.		
a. Assists in securing shoe to foot.		
b. Made of signal halyard because of its strength and flexibility.		
5. Leather Straps.		
a. Assists in securing shoe to foot.		
b. Aids in preventing laces from becoming tangled.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
6. Toe Guard--protects diver from injury.		
III. Questions and Summary	Ask questions as necessary.	

GPO 901-256

NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022
Medical Deep Sea Diving Technician A-433-0020
Ship Salvage Diving Officer A-4N-0011
Deep Sea (HeO2) Diving Officer A-4N-0010

Security Clearance: Unclassified

Lesson Topic: 6.2 Mk V Deep Sea Diving System Diver

12 1/2 Hours

INSTRUCTIONAL MATERIALS

U.S. Navy Diving Manual
Student Guides
Mk V Deep Sea Diving System
Projects-Materials for:
- Searching Project
- Single Flange Project
- Seventeen Stud Pontoon Project
- Tooker Patch Project

TERMINAL OBJECTIVES

1. When the student completes this course, he will be able to, as a diver using the Mk V Deep Sea Diving System, in open water at a depth of at least twenty feet:
   a. Demonstrate all searching line-pull signals and proper response to tender's searching line-pull signals during the execution of the Searching Project in accordance with Diving Training Standards.
   b. Demonstrate a proficiency in the use of the Mk V Deep Sea Diving System by successfully completing, in accordance with Diving Training Standards, any two of the following projects: Single Flange, Seventeen Stud Pontoon, or Tooker Patch.
   c. Use proper voice and line-pull communications during all training dives.

TERMINAL OBJECTIVES (cont'd)

ENABLING OBJECTIVES

1. LIST, in writing, all searching line-pull signals, and EXPLAIN the use of each.

2. Using a short line between two persons, DEMONSTRATE all searching line-pull signals.

3. Using a short line between two persons, DEMONSTRATE the correct response (movement) to the tender's searching line-pull signals.

4. Orally EXPLAIN the Searching,

ENABLING OBJECTIVES (cont'd)

Single Flange, Seventeen Stud Pontoon, and Tooker Patch Projects in accordance with Diver Training Standards.

5. Orally DESCRIBE operation and communication procedures for use on the Mk V Deep Sea Diving System Phone during normal operations (i.e. monitoring the dive, underwater cutting and welding and monitoring the Pneumo fathometer).

6. Orally DESCRIBE operation and communication procedures for use on the Mk V Deep Sea Diving System Phone during abnormal situations (i.e. loss of power, loss of communications, loss of gauge readings).

CRITERION TEST

As a diver using the Mk V Deep Sea Diving System, in open water at a depth of at least twenty feet:

a. Demonstrate all searching line-pull signals during the execution of the Searching Project in accordance with Diving Training Standards.

b. Demonstrate a proficiency in the use of the Mk V Deep Sea Diving System by successfully completing, in accordance with Diving Training

ENABLING OBJECTIVES (cont'd)

Standards, any two of the following projects: Single Flange, Seventeen Stud Pontoon, or Tooker Patch.

c. Use proper voice and line-pull communications during all training dives.

HOMEWORK

Student Guide, Volume C Assignment Sheets 6-2-1A through 6-2-3A ; Job Sheets 6-2-1J through 6-2-7J

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction		
A. Establish Contact	Introduce topic and self.	
B. Establish Readiness	Get students ready to learn.	
C. Establish Effect	Bring out the need and value of the material being presented.	
D. Overview	State learning objectives.	
II. Presentation		
A. Projects		
1. Searching	Explain the project in accordance with Diving Training Standards. EMPHASIZE: Must attain a satisfactory on this project.	Observe and take notes as necessary.
a. Line-pull signals (in Instructor Guide-Tender).		
2. Single Flange, Seventeen Stud Pontoon, and Tooker Patch.	Explain the project in accordance to Diving Training Standards. EMPHASIZE: Must attain a satisfactory performance on any <u>two</u> of these projects.	
B. Voice and Line-pull Communications		
1. Review line-pull signals (Diver to tender).		
a. 1 pull-"I am all right" or "I am on the bottom."	Ask students for definitions of line-pull signals.	Respond to questions as necessary.

b. 2 pulls-"Lower" or "Give me slack."

c. 3 pulls- "Take up my slack."

d. 4 pulls-"Haul me up."

e. 2-1 pulls-"I understand" or "Answer the phone."

f. 3-2 pulls-"More air."

g. 4-3 pulls-"Less air."

h. Emergency Signals.

1. 2-2-2 pulls-"I am fouled and need the assistance of another diver."

2. 3-3-3 pulls-"I am fouled but can clear myself."

3. 4-4-4 pulls-"Haul me up immediately."

i. Special Signals from the diver. Also covered in Mk V Deep Sea Diving System Tender Instructor Guide.

1. 1-2-3 pulls-"Send me a square mark."

2. 5 pulls-"Send me a line."

3. 2-1-2 pulls-"Send me a slate."

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
j. Searching Signals.	As in Mk V Deep Sea Diving System Tender Instructor Suide.	
2. Voice Communications	Emphasize that this is a graded evolution.	
a. Relay information to topside on status of diver and/or task when change occurs.		
b. Communications initiated by the diver begins with "Topside, this is (color code) . . ."	Example: "Topside, this is Red Diver-on the bottom."	
c. Repeat orders given by topside verbatim.		
d. Speak slowly and distinctly. Lower the normal pitch of your voice.		
e. Keep conversations brief and simple.		
f. Avoid other radio terminology.	Example: "Roger, Over-and-out, etc."	
g. No Profanity.		
III. Summary and Questions	Ask questions as necessary.	

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DIVING TRAINING STANDARDS

UNIT: 1. Orientation

2. Underwater Basic

DIVING COMMUNICATIONS STANDARDS

Following are standards to be used when grading, observing, and/or teaching Diving Communications.

LINE-PULL SIGNALS

1. In accordance with the U.S. Navy Diving Manual, line-pull signals should be:
   a. Sharp, distinct pulls.
   b. Strong enough to be felt by the diver.
   c. Not so strong as to pull the diver away from his work.
   d. Given after all slack has been taken from the line.

NOTE: If the instructor is in doubt as to whether or not tenders are giving proper line-pull signals (as above), place your hand on the line and check for slack, distinctness, etc.

VOICE COMMUNICATIONS

As a Phone Talker:

1. Color code first at all times with the exception of telling the diver to circulate.
   EXAMPLE: "Red Diver. Coming to your first stop."
   EXAMPLE: "Circulate, Red, Circulate."
2. Insure that the diver repeats the given order verbatim to the phone talker. Repeat the order if not given back verbatim.
3. Repeat, to the diver, any communication from the diver, verbatim.
4. Speak slowly and distinctly. Lower the normal pitch of the voices.
5. Keep conversations brief and simple.
6. Avoid other radio terminology (i.e. Roger, Over and Out, Wilco, etc.).
7. No profanity.

As a Diver

1. Relay information to topside on status of diver and/or task when change occurs.
2. Communications initiated by the diver begins with "Topside, this is (color code)."
   EXAMPLE: "Topside, this is Red Diver - on the bottom."

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3. Repeat orders given by topside, verbatim.
4. Speak slowly and distinctly. Lower the normal pitch of your voice.
5. Keep conversations brief and simple.
6. Avoid other radio terminology (Roger, Over and Out, Wilco etc.).
7. No profanity.

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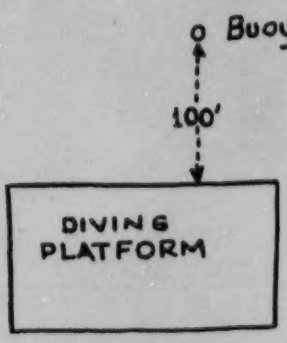
DIVING TRAINING STANDARDS

TASK: Searching

UNIT: 1. Underwater Basic

2. Lightweight Diving



GENERAL DESCRIPTION: Diver responds correctly to searching line-pull signals by moving in direction indicated by diving tenders.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Water	Open Water	
2. DEPTH	at least 20 feet	at least 20 feet	
3. EQUIPMENT	Mk V Deep Sea Diving System	Mk I Mask and Hot Water Suit	
4. OTHER	Murky water or with faceplate blacked out	Murky water or with faceplate blacked out	

STANDARDS:

1. PERFOPMANCE	Correctly respond to all searching line-pull signals	Correctly respond to all searching line-pull signals.	
2. TIME	30 Minutes	30 Minutes	
3. EQUIPMENT	Submerge portable buoy two times by hand pulls while standing on the bottom	Submerge portable buoy two times by hand pulls while standing on the bottom	

(8)

PROCEDURES:

1. Diver descends to bottom.
2. Diver reports on bottom and ready to go on searching pattern.
3. After the project is complete, use proper line-pull communications and come to surface.

WHY DO IT:

To give the student experience and training in techniques of finding objects on the bottom in dark water.

SKILLS NEEDED:

Sense of direction
Nominal proficiency in Mk V Deep Sea Diving System

SPECIAL INSTRUCTIONS:

1. Diver should be allowed a maximum of three minutes to become oriented on the bottom before beginning searching pattern.

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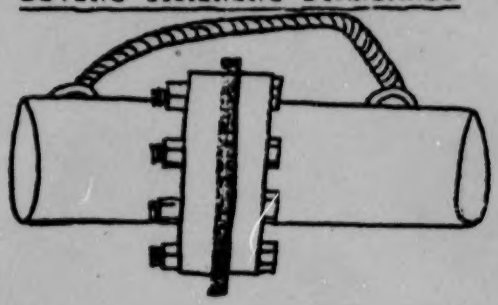
DIVING TRAINING STANDARDS

TASK: Single Flange



UNIT: 1. Orientation
2. Underwater Basic
3. SCUBA

GENERAL DESCRIPTION: Diver descends to bottom of open tank/open water, disassemble and reassemble, with gasket, the single flange project.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Tank	Open Water	Open Water
2. DEPTH	at least 8 feet	at least 20 feet	at least 20 feet
3. EQUIPMENT	Mk V System Tool Bag 2 open-end wrenches	Mk V System Tool Bag 2 open-end wrenches	SCUBA gear and wet suit Tool Bag and 2 open-end wrenches
4. OTHER	NONE	Murky water or faceplate blacked out	NONE

STANDARDS:

1. PERFORMANCE	Use proper line-pull signals	Use proper line-pull signals	NONE
2. TIME	60 Minutes	60 Minutes	30 Minutes
3. EQUIPMENT	1. Bench marks alined. 2. At least 6 nuts and bolts wrench tight	1. Bench marks alined. 2. At least 6 nuts and bolts wrench tight.	1. Bench marks alined. 2. At least 6 nuts and bolts wrench tight

PROCEDURES:

1. Disassembling
   a. Descend project to bottom.
   b. Diver removes nuts, bolts and gasket.
      (1) Put nuts and bolts in tool bag.
   c. Use line-pull signals and send for square mark.
   d. Secure gasket to square mark and send it topside.
   e. Recover gasket from topside.
2. Reassembling
   a. Reassemble flange in reverse order making sure bench marks are alined and gasket is in place.

WHY DO IT:

To acquaint the student with minor jobs underwater and the requirement for a water tight flange fitting.

SKILLS NEEDED:

Basic mechanical

Be able to overcome the restrictions created by the Mk V and SCUBA systems.

SPECIAL INSTRUCTIONS:

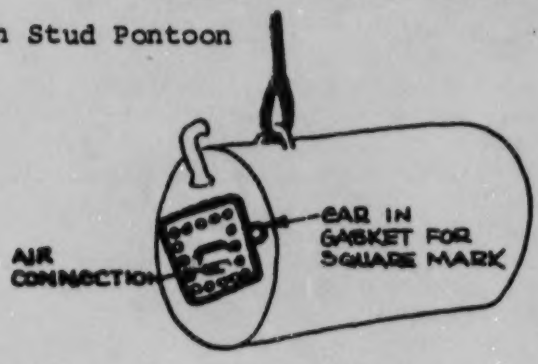
1. Time is to start when diver reports he in on the bottom and has located project.
2. Time is to be stopped when diver calls for project to be hauled topside.
3. Instructor must insist on use of proper line-pull signals and voice communications throughout all training dives.

1371

DIVING TRAINING STANDARDS

TASK: Seventeen Stud Pontoon

UNIT: 1. Underwater Basic



GENERAL DESCRIPTION: Remove/replace patch so that pontoon may be floated by using air.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Water		
2. DEPTH	at least 20 feet		
3. EQUIPMENT	1. Mk V System 2. Tool Bag 3. Wrenches		
4. OTHER	Murky water or blackened face plate		

(12)

STANDARDS:

1. PERFORMANCE	Use proper line-pull signals		
2. TIME	60 Minutes		
3. EQUIPMENT	1. At least 13 nuts wrench tight 2. Pontoon must float for 3 minutes after blowup.		

PROCEDURES:

1. Place project on bottom on the project whip.
2. Diver descends to bottom on the project whip.
3. Diver loosens all nuts.
4. Remove all nuts with the exception of those on the four corners. Place nuts in the tool bag.
5. Remove three of the remaining four bolts and place in tool bag.
6. Back off remaining nut to within two threads and request square mark from topside.
7. Secure line to rubber gasket, remove final nut and patch and send gasket to surface.
8. Recover gasket, set in place, and put four corner nuts in place. Screw down hand tight.
9. Place remaining nuts on studs and screw down hand tight.
10. Secure all nuts wrench tight beginning with center nut on each side and work toward corners.
11. Request air hose from topside and attach to pontoon.

WHY DO IT:

Gives the student experience in removing/replacing patches.

SKILLS NEEDED:

Basic mechanical

SPECIAL INSTRUCTIONS:

1. Time starts when diver has been on bottom three minutes.
2. Time stops when diver reports leaving the bottom.

(13)

1373

DIVING TRAINING STANDARDS

TASK: Tooker Patch

UNIT: 1. Underwater Basic

2. SCUBA

GENERAL DESCRIPTION: Diver removes and replaces a strong back in a tooker patch.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Water	Open Water	
2. DEPTH	at least 20 feet	at least 20 feet	
3. EQUIPMENT	1. Mk V System	1. SCUBA gear and wet suit	
4. OTHER	Murky water or blackened face plate		

STANDARDS:

1. PERFORMANCE	Use proper line-pull signals	NONE	
2. TIME	25 Minutes	7 Minutes	
3. EQUIPMENT	Patch properly seated	Patch properly seated	

(14)

PROCEDURES:

1. Place project on the bottom on project whip.
2. Diver descends to bottom on the project whip.
3. Diver removes two wing nuts from patch studs.
4. Diver removes strong back.
5. Diver requests square mark from topside, secures strong back to square mark and sends it topside.
6. Receive strong back from topside and reassemble project.

WHY DO IT:

Give student experience securing tooker patches such as are used in port holes during salvage operations.

SKILLS NEEDED:

Basic mechanical

SPECIAL INSTRUCTIONS:

1. Time starts when diver reports that he is on the bottom.
2. Time stops when diver reports that he is leaving the bottom.

(15)

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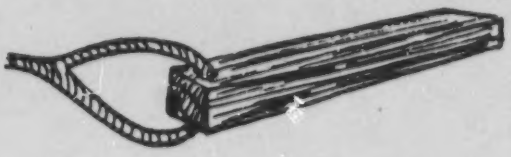
DIVING TRAINING STANDARDS

TASK: Timber Hitch and Half Hitch on a Spar

UNIT: 1. Underwater Basic



GENERAL DESCRIPTION: Diver pulls timber to the bottom, ties a timber hitch backed with a half hitch around the timber, and returns it to the surface.

CONDITIONS:	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Water		
2. DEPTH	at least 8 feet		
3. EQUIPMENT	1. Mk V System		
4. OTHER	Murky water or face plate blacked out.		

STANDARDS:			
1. PERFORMANCE	1. Without error		
2. TIME	13 Minutes		
3. EQUIPMENT	1. Timber hitch and half hitch must not slip off when timber reaches the surface.		

(16)

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PROCEDURES:

1. After descent, diver pulls spar down with project line and straddles timber.
2. Diver ties a timber hitch backed with a half hitch around timber.
3. Hold on to the line just below the half hitch and let timber float upward.
4. Give proper line-pull signals and return to the surface.

WHY DO IT:

1. To familiarize the student with handling lines and wood underwater.
2. To allow the student to gain confidence and dexterity in the Mk V System.

SKILLS NEEDED:

Basic Marlinspike Seamanship

SPECIAL INSTRUCTIONS:

1. Time starts when timber leaves the surface.
2. Time stops when diver leaves the bottom.
3. Students should try tying timber hitch and half hitch while on surface (opportune time would be while they are dressed in the Mk V waiting to be put in water).

GPO 801-287

Diver, Second Class A-433-0022
Medical Deep Sea Diving Technician A-433-0020
Ship Salvage Diving Officer A-4N-0011
Deep Sea (HeO2) Diving Officer A-4N-0010

Security Clearance: Unclassified

Lesson Topic: 6.3 Mk V Deep Sea Diving System Tender

12 1/2 Hours

INSTRUCTIONAL MATERIAL:

U.S. Navy Diving Manual, Vol. 1
Student Guides
Mk V Deep Sea Diving System
Normal Classroom Equipment
Short piece of line per 2 students
Surface Supplied Diving Operations Pre-dive Checklist
Diving Log
OPNAV Form 9940/1 per student

TERMINAL OBJECTIVES

1. When the student completes this course, he will be able to, as a member of a team tending a diver using the Mk V Deep Sea Diving System in open water:

   a. Given directions by the topside supervisor (Instructor), guide the diver through the Searching Project (in accordance with Diving Training Standards) by using correct searching line-pull signals.

TERMINAL OBJECTIVES (cont'd)

   b. Use correct telephone and line-pull communication procedures throughout all training dives.

   c. Dress a diver in a Mk V Deep Sea Diving System, within twelve minutes, so that he may safely enter the water.

   d. Under instructor guidance, prepare the Mk V Deep Sea Diving System for daily use and secure the gear upon completion of daily diving activities.

   e. Demonstrate correct maintenance of the Diving Log (including OPNAV Form 9940/1) without error.

ENABLING OBJECTIVES

1. LIST, in writing, all searching line-pull signals.

2. Using a short line between two persons, DEMONSTRATE all searching line-pull signals.

3. DESCRIBE, orally, operation and communication procedures for the use of the Mk V Deep Sea Diving System Phone during normal operations (monitoring the dive, underwater cutting and welding, and monitoring the pneumo fathometer).

4. DESCRIBE, orally, operation and communication procedures for use on the Mk V Deep Sea Diving System Phone during abnormal operation (i.e. loss of power, loss of communications, loss of gauge reading).

5. DESCRIBE, in writing, correct procedures for maintaining a diving log during normal/abnormal operations as described in 3 and 4 above.

6. Orally EXPLAIN the function of OPNAV Form 9940/1.

7. Orally EXPLAIN the function of the Report Overlay and Report Form of the OPNAV Form 9940/1.

8. DESCRIBE, in writing, the proper completion of the OPNAV Form 9940/1, during normal operations, without error.

ENABLING OBJECTIVES (cont'd)

9. Orally EXPLAIN the steps and equipment checkout involved in securing the Mk V Deep Sea Diving System from daily use (particular attention to cleaning and stowage).

CRITERION TEST

1. As a member of a team tending a diver using a Mk V Deep Sea Diving System in open water:

   a. Given directions by the topside supervisor (Instructor), guide the diver through the Searching Project (in accordance with Diving Training Standards) by using correct searching line-pull signals.

   b. Use correct telephone and line-pull communication procedures throughout all training dives.

   c. Dress a diver in a Mk V Deep Sea Diving System, within twelve minutes, so that he may safely enter the water.

   d. Under instructor guidance, prepare the Mk V Deep Sea Diving System for daily use and secure the gear upon completion of daily diving activities.

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HOMEWORK

Student Guide, Volume C Assignment
Sheets 6-3-1A through 6-3-4A

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction		
A. Establish Contact	Introduce Topic and self.	
B. Establish Readiness	Get students ready to learn.	
C. Establish Effect	Bring out need and value of the material being presented.	
D. Overview	State learning objectives.	
II. Presentation		
A. Communication Procedures		Take notes and ask questions as necessary.
1. Normal Conditions.		
a. Monitoring the dive.		
1. Tender will normally "feel" the diver by taking up slack, getting the feel of the diver's movement and then giving more slack.	Demonstrate.	
2. Phone Tender will initiate conversations with diver at the direction of the topside supervisor.		

3. Line-pull and Phone Tender will monitor diver constantly. Emphasize
4. Both tenders will respond to diver as necessary.

b. Underwater Cutting and Welding.

1. Safety precautions make it desirable to have as much voice contact with diver as possible during the time the knife switch is "on."
   (a) Possibility exists that the diver could be electrocuted.
2. As a rule, if phone talker has had no communication from diver for 1-1 1/2 minutes after "switch on," he should put knife switch in "off" position and query diver. Emphasize. Time is dependent upon welding/cutting electrodes being used and their rate of burn.

c. Monitoring the Pneumo fathometer.

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY STUDENT ACTIVITY

1. Constant monitor during descent and ascent.
2. Bottom conditions will dictate whether constant monitoring on the bottom is necessary.
   (a) Flat bottom or rough, muddy, etc.

Note: Purge Pneumofathometer once per 10 ft. on descent. Do not purge on ascent.

2. Abnormal Conditions.

   a. Loss of power/communications.

      1. Go immediately to line-pull signals. Keep in mind that they may not always work.
         (a) Depth, current, bottom or work site communication.
      2. Check the rising bubbles of air.
      3. Listen for sounds from the diving helmet.
         (a) If sounds are not heard,

Take notes and ask questions as necessary.

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circuit may be out of order. If the flow of bubbles seems normal, diver may be all right.

4. If sounds are heard, but diver does not respond, assume he is in trouble.
5. If another diver is on the bottom, have him investigate or send down the standby diver.
6. If there is doubt about the diver's condition, do not hesitate to start bringing him to the surface. The standby diver can meet him on the way, or communication may be restored.

b. Loss of Gauge Readings.

1. Most serious when depth and

time of dive require decompression stops. Explain.

2. Actions.

(a) If using a diving stage, marks on stage line could be used.

(b) Lengths (50') of hose could be used.

(c) Best method would be to lower a measured and marked line to the diver.

1. Sliding shackle on descent line held in position at stop level. Puts burden of maintaining proper level on diver.

2. Let diver hold weighted end during ascent.

3. As directed by topside supervisor. Emphasize that there are no standardized procedures for this instance.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
3. Procedures		
a. As a Phone Talker.	Explain that these are also the standards for grading line-pull/phone tenders. EXAMPLE: "Red Diver coming to first stop." EXAMPLE: "Circulate, Red, Circulate."	Take notes and ask questions as necessary.
1. Color code first at all times except when telling the diver to circulate.		
2. Insure that the diver repeats the given order <u>verbatim</u> to the phone talker. Repeat the order if not given back verbatim.		
3. Repeat, to the diver, any information from the diver, <u>verbatim</u>.		
4. Speak slowly and distinctly. Lower the normal pitch of the voice.	Demonstrate.	
5. Keep conversations brief and simple.		
6. Avoid other radio terminology		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(i.e. Roger, Over-and-out, etc.).		
7. No profanity.		
b. Line-pull Signals		Take notes and ask questions as necessary.
1. Searching Line-pull Signals.	Explain reasons for searching signals.	
(a) 7 pulls-"Go on/off searching signals."	All signals must be answered. Emphasize.	
(b) 1 pull-"Stop and search where you are."		
(c) 2 pulls-"Move directly away from the tender if given slack or move toward tender if strain is taken on the life-line."		
(d) 3 pulls-"Move to your right." (facing tender).	Emphasize: Directions are from facing the tender.	
(e) 4 pulls-"Move to your left." (facing tender).		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. Searching Signals (with circling line). (a) 7 pulls & 1 pull same as above. (b) 3 pulls-"Face the weight and go right." (c) 4 pulls-"Face weight and go left."	Explain when to use.	
3. Special Signals from the diver. (review) (a) 1-2-3 pulls-"Send me a square mark. (b) 5 pulls-"Send me a line." (c) 2-1-2 pulls-"Send me a slate."	May ask students to explain definitions or when signals would be used.	
4. Grading Line-pull Signal Tenders. (a) Sharp, distinct pulls.	Demonstrate as explaining.	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(b) Strong enough to be felt by the diver.		
(c) Not so strong to pull the diver away from his work.		
(d) Given after all the slack has been taken from the line.		
5. Practice Line-pull signals.	Pass out short pieces of line. Pair up students. Designate one as tender, one as diver.	Students pair up-one tender, one diver.
(a) Searching signals--Give as "move left," "move right," etc. (vice 3 pulls--4 pulls)	Instruct which line-pull signal the tender should give the diver. Diver should respond by repeating signal, and appropriate movement.	Place short piece of line issued by instructor between the pair. Designated tender give line-pull signals as directed. Designated diver will answer the line-pull signals and then move accordingly.
	Observe student progress and correct mistakes as necessary.	
	Switch student roles and practice.	Switch diver/tender roles and repeat.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
B. Prepare/Secure the Mk V Deep Sea Diving System		
1. Introduction to Pre-Dive Checklist.	Appendix K, Diving Manual, Volume I.	
2. Instructions for students.		
a. Each morning/afternoon a team of 4 students and one instructor will prepare Mk V Deep Sea Diving System for use.	1. Assign team of four students for each morning. 2. Following to be accomplished each morning under direction of the instructor. a. Perform applicable portions of the Surface Supplied Diving Operations Pre-Dive Checklist to prepare the Mk V Deep Sea Diving System. b. This should include everything from hoisting the diving flags to properly aligning the air system to accomplishing all inspections of the diving equipment.	Perform under direction of the instructor.
C. Diving Log		
1. Normal Diving Operations.	Illustrate on C/B.	Take notes as necessary.
a. Kept on diving station in regular green hard-backed notebook.		
b. Left column:		

1. Diver: (Name)
2. Tenders: (Names)
3. Media: (Air, HeO2)
4. Dress: (Mk V, KMB-9, etc.)
5. Depth: (in feet)
6. For School only:

   (a) Instructor: (lead instructor's name)

   (b) Project: (single flange, etc.)

   (c) Remarks:

c. Right Column:

1. LS: (Time Left Surface)
2. RB: (Time Reached Bottom)
3. LB: (Time Left Bottom)
4. RS: (Time reached surface, or decompression stops, if necessary)
5. TDT: (Total Decompression Time)

6. TBT: (Total Bottom Time)

7. TTD: (Total Time of Dive)

8. For School Only:

(a) Project Time:

d. First dive of the day will have following entry written across the top: "Non-Returns and Jocks (if applicable) Tested by: (name)" Emphasize that only the equipment actually tested should be entered.

2. Abnormal Operations.

a. Accidents, incidents, etc. should be entered in the "Remarks" section of the log, to include:

1. Description of event--keep brief.

2. Actions taken.

D. OPNAV Form 9940/1, Diving Log Accident/ Injury Report Distribute 9940/1 and overlay to each student. Create normal dive situation for use in completing the form. Take notes and ask questions as necessary.

1. Background.

a. Formal report for reporting diving

information for data machine processing.

b. Filled in by all Navy diving activities, military and civilian, excluding submarine school students in escape training, unless an accident or incident is incurred.

c. Forward to:

Commander
Naval Safety Center
Naval Air Station
Norfolk, VA 23511
ATTN: Code 88

d. Must be sent within ten(10) days.

e. In case of death, forward to:

Armed Forces Institute of Pathology
Washington, D.C. 20012
ATTN: Marine Bropathology Branch

Plus one copy to Naval Safety Center (above).

2. Completing the 9940/1. Use actual form, Take notes and ask questions as necessary.

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OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

a. Six (6) lined multi-spaced form filled in with the aid of an over-lay.

chart, or transparency to demonstrate as explaining.

1. Lines 1-5 completed by the first diver of the group.

(a group is any number of divers making that same dive)

(a) Other divers of that group fill in only line 1-2 if everything else is the same.

(b) If any variations, line 4-5 will be completed.

2. If decompression schedule is not followed or an accident/ injury occur, line 1,2,6 with a narrative of events will be used.

(a) For recurrence--a separate 9940/1, line 1-6 and narrative is used.

(b) Line 1 and 2 will be as first 9940/1.

3. For normal or routine dives, narrative is not required.

4. The overlay contains self explanatory instructions and code symbols.

(a) Use only #2 pencil.

(b) Use only one symbol. per block.

5. Line 1

(a) Completed on all 9940/1's.

(b) Blocks 2-3: Month

(c) Blocks 4-5: Day

(d) Blocks 6-7: Year

(e) Blocks 8-13: Unit I.D. Code Give school as example.

(f) Blocks 14-15:

(g) Blocks 16-17: total number

of divers in the group.

(h) Blocks 18-19: position of diver in that group.

Note: Any item using two blocks where one number is used must be preceeded by a zero (01, 02, 03, etc.)
Note: If blocks 16-17 has number of divers as 10, then 10 reports must be submitted.
Note: All 9940/1's of a group are stapled together.

6. Line 2

(a) Completed on all 9940/1's.

(b) Blocks 20-33: Activity Code. Give for school, as example.

(c) Blocks 34-42: Social Security Number.

(d) Blocks 43-56: Diver's last name, first and middle initial. Note: Leave space between name and initials. Use only spaces provided for name.

(e) Blocks 57-58: Diver's Age.

(f) Blocks 59-60: Diver's

Height (in inches)

(g) Blocks 61-63: Diver's Weight

(h) Block 64: Male or female

(i) Block 65: Marital Status

(j) Block 66: Diver's Race

(k) Block 67: Branch of Service

(l) Block 68: Diver's Build

(m) Block 69: Class of Diver

Note: When Y is used in line 1-6 explain in remarks, "line 2-Block 69 Y Foreign Student."

(n) Block 70: Number of dives in last 24 hours

7. Line 3

(a) Blocks 20-24: Time, locale, Zone

(b) Blocks 25-35: Locality

(c) Blocks 36-39: Depth in feet actual — 10 feet would be written 0010

(d) Blocks 40-41: Average wave height

(e) Blocks 42-44: Current speed in knots

(f) Blocks 45-47: Air temperature F°

(g) Blocks 48-50: Water surface temperature

(h) Blocks 51-53: Water bottom temperature.

(i) Blocks 54-57: Visibility on bottom

(j) Block 58: Type of bottom — Note: Open tanks and pressurized pots are Y (with explanation)

8. Line 4

(a) Block 20: purpose of dive

(b) Block 23: Is D/S, HeO2, L/W

fill in B, SCUBA is either C or D

(c) Block 25: Type of equipment

(d) Block 27: Type of dress

(e) Block 28: If diving underwear is used, fill in Y (with explanation)

(f) Blocks 29-41: Breathing media — Note: An air dive is He OO N2 79, 02 021, Y00.

(g) Blocks 42-45: Maximum depth of dive

(h) Blocks 46-52: Bottom time

(i) Block 53: Breathing mix — Note: P unless any changes to the diver.

(j) Block 54: Breathing mix supplied by air (D)

(k) Block 55: Tools used, any tools Y (with explanation)

(l) Block 56: Type work, explain diving stage. No work

(m) Block 57: Diver performance

9. Line 5

(a) Block 20: Decompression Schedule

(b) Blocks 21-24: Depth on partial pressure table

(c) Blocks 25-28: Time, explain (table 1-10) a dive 149' for :08 is 150/10 or 0150/0010

(d) Blocks 29-33: Repetitive dive interval

(e) Block 34: Type decompression

(f) Block 35: Location of decompression

(g) Blocks 36-53: Decompression

Note: Fill in the scheduled and actual time. Round seconds to next greater minute.

(h) Block 54: If schedule was followed or not

(i) Block 55: If accident occured or not

10. Line 6

(a) Filled out only for accident, injury, or medical information. Overlay gives specific details

11. Narrative

(a) Required if decompression schedule is not followed or accident occurs

(b) Signature of Diving Supervisor and Diving Officer will be in lower portion of narrative lines

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
3. Scoring the Logs	Emphasize: This is a part of this unit's grade.	
a. Station Logs		
1. Will be checked by instructor following each dive.		
(a) Accuracy of information.		
(b) Completeness of information.		
(c) Ledgibility.		
b. 9940/1's.		
1. Will be checked by instructors each morning for dives made the preceeding day.		
(a) Accuracy of information.		
(b) Completeness.		
(c) Ledgibility		
E. Summary and Questions	Ask questions as necessary.	

1602

GPO 901-284

NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022
Medical Deep Sea Diving Technician A-433-0020
Ship Salvage Diving Officer A-4N-0011
Deep Sea (HeO2) Diving Officer A-4N-0010

Security Clearance: Unclassified

LESSON TOPIC: 7.1 Surface Supplied Diving Operation Pre-Dive Checklist

9 Hours

INSTRUCTIONAL MATERIALS

U.S. Navy Diving Manual, Vol. I
Student Guides
Standard Classroom Equipment
Mk V Deep Sea Diving System

TERMINAL OBJECTIVE

1. When the student completes this course he will be able to, as a member of a four-man team, complete the applicable items of the Surface Supplied Diving Operations Pre-Dive Checklist to prepare the Mk V Deep Sea Diving System for daily use and secure the gear upon completion of the daily activities.

ENABLING OBJECTIVES

1. Orally EXPLAIN the use of the Surface Supplied Diving Operations Pre-Dive Checklist.

2. DEMONSTRATE the correct procedures for completing the items necessary for preparation of the Mk V Deep Sea Diving System for daily use.

3. Using a standard print (illustration) of the school's diver's breathing air system:
   a. LABEL the print with correct symbols to show all major components.
   b. For the major components:
      (1) EXPLAIN, in writing their function.
      (2) LIST, in writing, the protective devices within the system.
      (3) DESCRIBE, in writing, the protection provided by each device.
      (4) LIST, in writing, the ratings of applicable major components and materials used in their contruction.

4. Orally DESCRIBE the maximum standards for breathing air and the reasons for the standards.

5. Orally STATE the setpoint(s) for cleaning, test and calibration of gauges.

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ENABLING OBJECTIVES (cont'd)

6. STATE, in writing, the safety precautions necessary to insure air purity.

7. DEMONSTRATE the correct procedures for completion of items necessary to secure the Mk V Deep Sea Diving System from daily activities.

CRITERION TEST

As a member of a four-man team, complete the applicable items of the Surface Supplied Diving Operations Pre-Dive Checklist to prepare the Mk V Deep Sea Diving System for daily use and secure the gear upon completion of the daily activities.

HOMEWORK

Student Guide Volume G, Assignment Sheets 7-1-1A through 7-1-5A.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction		
A. Establish Contact	Introduce self and topic.	
B. Establish Readiness	Get students ready to learn.	
C. Establish Effect	Bring out need and value of material being presented.	
D. Overview	State learning objectives.	
II. Presentation		
A. Diver's Breathing Air System	Emphasize: The air system taught here is for the school only. Although there may be similarities, the air system for their command will probably be different in design or components.	Observe and take notes as necessary.

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY STUDENT ACTIVITY

1. General

   a. Compressor

      1. High pressure.

      2. Rated 3000 psi.

   b. Filter

   c. High pressure banks

      a. 3 banks.

   d. Reducer

      1. Reduced to 150 psi.

   e. Volume tanks

      1. 150 psi.

   f. Manifold

      1. Bays.

      2. 5 air connections.

   g. Luffer Sponges.

   h. Diver's umbilical.

2. High pressure Compressors

   a. 2 (#1 & #2) available.

Use drawing (attached) to diagram on C/B, transparency or chart to illustrate.

1608

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
b. Made by Chicago Pneumatic.		
c. Used to maintain air pressure in high pressure banks.		
d. Rated 3000 psi.		
e. Not a constant service compressor.	Explain.	
f. Electrically driven.		
g. 4 stages.		
h. Located in Compressor Room (Building 214).		
i. High pressure alarm goes off at 3000 psi.		
3. High Pressure Air Flasks		
a. 3 banks.	Use drawing (attached) to	
b. 8 flasks per bank.	diagram on C/B, transparency	
c. Each flask has a valve for individual control.	or charts to illustrate.	
d. Hydrostatic testing at 4500 psi.		

e. Do not have relief valves.

4. Low Pressure Air Compressors

a. Not in use at school.

b. On board YDT 14 & 15 with Bendix Filter.

1. 150 psi.

2. Manufacturer I&R.

c. Usually portable or Salvage Compressor.

d. Constant Service Compressor.

5. Volume Tank (Low Pressure)

a. Used with L.P. Compressor.

b. Used with reduced H.P. Air.

6. High Pressure Piping

a. Usually H.P. thick wall copper tubing.

1. 1/8" wall thickness.

b. CPV* valves normally used. *Combination Pump Valve.

c. 3000 psi working pressure.

d. Relief Valve installed 3300 psi.

e. Tested at 4500 psi.

f. Used from H.P. Compressor to H.P. Banks to Reducer.

7. Low Pressure Piping.

a. Carries normal diving air pressure.

b. Copper, steel or brass tubing.

c. 150 psi normal pressure.

d. Tested to 1 1/2 times working pressure.

e. Relief Valve lifts at 10% over work pressure.

8. Filters Show.

a. Function--eliminate dust, oil, etc. from air.

b. Two types.

1. Between compressor and banks/ volume tanks.

(a) Cuno, Bendix.

(b) Changeable element.

2. Before going to diver.

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(e) Luffer--sponge or fiber; cleaned with soap and water.

9. Pressure Reducers

a. Normally dome type. Show.

b. Manufactured by Grove Co.

c. Reduces high pressure air to desired lower pressure.

1. Can set at any lower pressure.

10. Hand Loader

a. Manufactured by Grove Co.

b. Direct control of air pressure.

c. Used with mixed gas diving to maintain over-bottom pressure during descent and ascent.

11. Other Accessories

a. Moisture Separator.

1. Collects moisture from system after leaving compressor.

b. Relief Valves. 1612

1. Relieves pressure from system when it rises above working pressure.
2. Set at 10% over working pressure.

c. Gauges.

1. Installed in system for direct pressure reading.
2. Calibrated according to PMS Requirements.

d. Crow's Foot.

1. For diving more than one diver (maximum of three).

e. "T" Fitting.

1. Diver's thread on one end, torpedo thread on the other.
2. Double male.

f. "S" Fitting.

1. Double male.
2. 3/4" pipe thread on one end, diver's

air thread on the other.

g. Double Male Fitting.

1. Diver's air thread.

h. Double Female Fitting.

1. Diver's air thread.

i. Oil Separator.

1. Removes oil from system after compressor.

j. Heaters and Coolers.

1. Used to maintain desired temperature.

2. Steam or water used.

3. Tube Type.

B. Diver's Breathing Air Standards.

1. Must conform to the following:

a. Oxygen 20-22% by volume.

b. Carbon Dioxide 300-500 parts per million; .03-.05% by volume.

c. Carbon Monoxide 20 parts per million

maximum, .002% by volume.

d. Oil, Mist, and Vapor 5 milligrams per cubic millimeter maximum.

e. Solid and Liquid Particles--not detectable except as noted above under Oil, Mist, or Vapor.

f. Odor-not objectionable.

2. Insure quality by:

a. Using U.S. Navy approved diving compressors only.

b. Use only approved lubricants.

c. Have air analyzed regularly.

d. Insure moisture is drained from compressors periodically while running.

e. Air stored in flasks will be drained and recharged annually.

f. Never put a diver in the water if air is in question.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
C. School Air System Checkout	Walk through air system used for diving bay/platform used for Underwater Advanced. Begin with compressors and end with diving umbilical. Point out all filters, air banks, high pressure lines, reducers, etc. Emphasize safety and tag-out procedures.	Follow instructors through air system checkout. Ask questions as necessary.
D. Diving Station Set-up	Using the Surface Supplied Diving Operations Pre-Dive Checklist (Appendix K, U.S. Navy Diving Manual, Vol. I), attached, complete all items necessary to set up station for Mk V Deep Sea Diving System operations. Emphasize safety, thoroughness of inspections, and completion of all necessary checklist items.	Follow instructor through diving station set-up procedures. Ask questions as necessary.
E. Grading Procedures for Diving Station Set-up	Emphasize items to be checked each day.	Ask questions as necessary.
1. Divide class into teams of 4 students. These will be responsible for setting		

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up/securing equipment for daily diving activities.

2. Instructors will accompany team as they complete Surface Supplied Diving Operations Pre-Dive Checklist each morning/afternoon.
3. Teams should be graded satisfactory if:
   a. All items of checklist are completed.
   b. All safety inspections are properly completed.
   c. The Mk V Deep Sea Diving System is ready/secured at completion of checklist.

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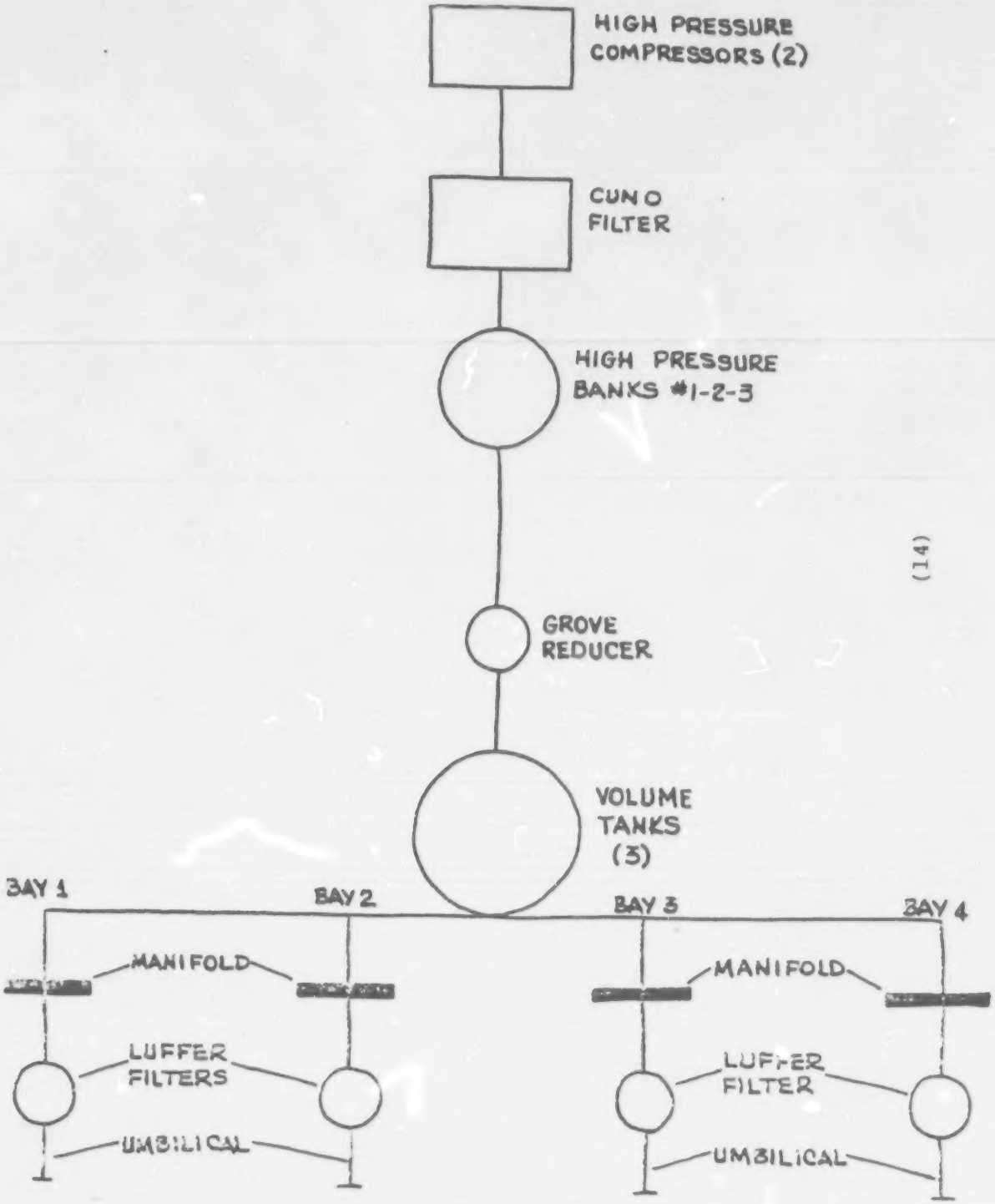
SCHOOL AIR SYSTEM



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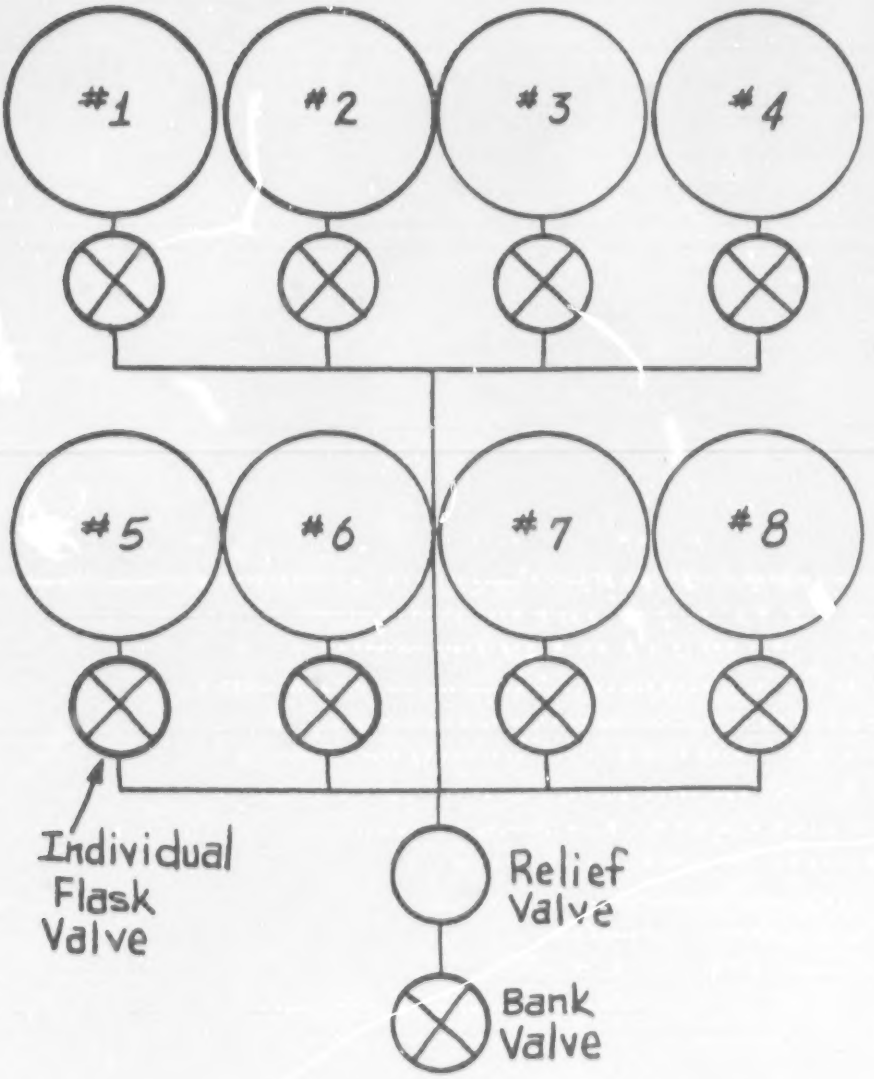

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HIGH PRESSURE AIR BANK

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APPENDIX K

SURFACE-SUPPLIED DIVING OPERATIONS PRE-DIVE CHECKLIST

PRE-DIVE CHECKLIST

■ **A. Basic Preparation**

- ■ 1. Check that, for dives over 170 feet, a recompression chamber and diving medical officer are present on the diving station.
- ■ 2. Verify that the proper signals indicating underwater operations are being conducted are properly displayed.
- ■ 3. Make sure that all personnel concerned or in the vicinity have been informed that diving operations are underway.
- ■ 4. Determine that all valves, switches, controls and equipment components that influence the diving operation are properly "tagged-out" to prevent inadvertent shut-down or activation.

■ **B. Equipment Preparation**

- ■ 1. Assemble all members of the diving team as well as support personnel (winch operators, boat crew, watchstanders, etc.).
- ■ 2. Assemble and lay out all equipment that may be used on the dive, either as primary equipment or standby spares for the diver (or standby diver). This should include all accessory equipment and tools.
- ■ 3. Check all equipment for superficial wear, tears, dents, distortion or any other apparent discrepancies.
- ■ 4. Check all masks, helmets, viewing ports, faceplates, seals, and visors for broken glass or plastic.
- ■ 5. Check all belts, laces, and lanyards for wear and renew as needed.

■ **C. Deep-Sea Outfit**

- ■ 1. Check the rubber gasket on all helmet faceplates for wear.
- ■ 2. Check the interior of the helmet to insure that all controls and components are dry and free of verdigris. Pay special attention to terminals for the diver's communication system.
- ■ 3. Check the threads on the goosenecks on the back of the helmets for breakage, verdigris or wear.
- ■ 4. Check the safety locking device on the helmet for freedom of action, and verify that the locking gate on the breastplate recess has a **brass** cotter pin.
- ■ 5. Check that all studs on the breastplate are free of distortion or damage to threads.
- ■ 6. Verify that each helmet and breastplate combination has four copper washers and twelve wing nuts. (4 wing nuts should be flanged).
- ■ 7. Check serial numbers on the breastplate brales (straps) to insure that the proper brales are matched to a corresponding breastplate.
- ■ 8. Check the operation of the air nonreturn valve (smoke test). (16)
- ■ 9. Check the packing on the air control valve. Verify presence of the cotter key.
- ■ 10. Check the freedom of movement of the spitcock and verify that the nut is loose but not coming off.
- ■ 11. Check the freedom of movement of both the handwheel and chin-button on the air exhaust valve.
- ■ 12. Check the diving dress for wear or tears. Pay particular attention to the rubber collar gasket, bib, and cuffs.
- ■ 13. Check leather, weights, and grommets on the weighted belt for wear or tearing. Pay particular attention to the jockstrap.
- ■ 14. Check that helmet cushion or suitable padding is available for placement on diver's shoulders before breastplate is attached.

☐ **D. Lightweight Diving Outfit (Standard Mask)**

☐ 1. Check the lightweight dry dress for rips or excessive wear.

☐ 2. Check the lightweight diving belt for wear.

☐ 3. Check mask for general appearance or discrepancies in frame and seal. Check mask straps.

☐ 4. Check mask air non-return valve (smoke test).

☐ **E. Lightweight Diving Outfit (Diver's Mask USN Mk I)**

☐ 1. Check wet suit for tears or excessive wear.

☐ 2. Check faceplate and seal on the Mk I mask.

☐ 3. Check that face seal and oral-nasal mask are properly attached to the main mask body.

☐ 4. Check that all metal components are properly secured to the fiberglass body.

☐ 5. Inspect the mask for loose mounting bolts or excessive dents or damage.

☐ 6. Check that the nose clearing device slides in and out easily.

☐ 7. Check mask straps for wear. Gage the "bail-out" bottle.

☐ 8. Check flippers, weight belt and other accessory equipment according to SCUBA equipment checklists in Chapter Five.

☐ **F. General Equipment**

☐ 1. Check that all needed accessory equipment, tools, lights, special systems, spares, etc. are on scene and in working order. In testing lights, all tests should be conducted with lights submerged in water and extinguished before the removal to prevent overheating and failure.

☐ 2. Erect the diving stage or attach the diving ladder. In the case of the stage, be careful to insure that the shackle connecting the stage line is securely fastened **with the shackle pin seized with the wire to prevent opening.** Secure the air-hose bulwark roller in place.

☐ **G. Preparing the Air Supply**

■ 1. Check that a primary and suitable back-up supply is available with a capacity in terms of **purity, volume,** and **supply pressure** to completely service **all** divers and accessory equipment throughout all phases of the planned operation.

■ 2. Determine that proper personnel are available to operate and stand watch on the air supply.

☐ 3. Compressors –

☐ a. Determine that sufficient fuel, coolant, lubricants, and antifreeze are available to service all components throughout the operation. All compressors should be fully fueled, lubricated and serviced (with all spillage cleaned up completely).

☐ b. Verify that the appropriate operating and service manuals are on hand.

☐ c. Check maintenance and repair logs to insure the suitability of the compressor (both primary or back-up) to support the operation.

☐ d. Verify that all compressor controls are properly marked and any remote valving is tagged-off with "Diver's Air Supply-Do Not Touch" signs.

☐ e. Make sure that the compressor is secure in the diving craft and will not be subject to operating angles that will exceed 15 degrees.

☐ f. Verify that the oil in the compressor is of a type that is

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proper for the particular compressor and is not petroleum-based. Check that the compressor oil does not overflow the "Fill" mark or contamination of the air supply could result from fumes or oil mist.

- ☐ g. Check that the compressor exhaust is vented away from work areas and, specifically, does not foul the compressor intake.
- ☐ h. Check that the compressor intake is obtaining a free and pure suction without contamination. Use pipe to lead intake to free suction is necessary.
- ☐ i. Check that compressors are not covered during operation.
- ☐ j. Check all filters, cleaners, and oil separators for cleanliness.
- ☐ k. Bleed off all condensed moisture from filters and the bottom of volume tanks (accumulators). All manifold drain plugs should be checked.
- ☐ l. Check that all petcocks are closed.
- ☐ m. Check that all belt-guards are properly in place on drive units.
- ☐ n. Check all pressure-release valves, check valves, and automatic unloaders. Make sure that the wing nut on the unloader is in the compressing position.
- ☐ o. Verify that all supply hoses running to and from the compressor have proper leads, do not pass near high-heat areas such as steam lines, are free of kinks and bends, and are not exposed on deck in such a way that they could be rolled over, damaged, or even severed by machinery or other activities.

☐ **H. Activate the Air Supply**

☐ **1. Compressors—**

- ☐ a. Make sure that all run-up and warm-up procedures are completely followed.
- ☐ b. Check all petcocks, filler valves, filler caps, overflow points, bleed valves, and drain-plugs for leakage or malfunction of any kind.
- ☐ c. Soap-test all valves and connections.
- ☐ d. Verify that there is a pressure gage on the air receiver and that it is functioning properly, and that the compressor is meeting its delivery requirements.
- ☐ e. Check that the air supply is not being delivered below purity standards (smell, taste), or in excess of 95°F.
- ☐ f. In all cases where compressors are used as a back-up, either to a shipboard system, cylinder bank, or another compressor—the back-up compressor will be **kept running** throughout the diving operation.

☐ **2. Cylinders—**

- ☐ a. Gage all cylinders for proper safety.
- ☐ b. Verify the availability and suitability of the reserve cylinders.
- ☐ c. Check all manifolding and valving for operation.
- ☐ d. Activate and check delivery.

☐ **3.** For **all** supply systems, double check "Do Not Touch" tags.

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I. Air Hoses

1. Check that all hoses have a clear lead and are not subject to heating or damage.
2. Check that no hose length used exceeds five years in age from the date of manufacture (age is marked on each length 4" from the end). Air hose used on ASR (Auxiliary Submarine Rescue) vessels may not exceed 3 years of age in any length.
3. If possible, make sure that the hose (or any length) has not been used in burst test program. No length involved in such a program may be part of an operational hose
4. Check that hoses are free of moisture, packing material, or chalk.
5. Soap test hose connections after they have been hooked up to the air supply and pressurized
6. Check that the newest (or best) hose length is the section nearest the surface, since that is the region in which the hose will be subjected to the greatest pressure change.
7. Check that all tie-offs, and the canvas chaffing over the first length of hose are in proper condition
8. If possible, check gaskets at hose-length connections.

J. Test of Equipment with Activated Air Supply

1. Hook-up all air hoses to helmets, masks, chambers, and make connections between back-up supply and primary supply manifold.
2. Verify flow to helmets and masks.
3. Check all exhaust and air control valves.
4. Hook up and test all communications
5. Check air flow from both primary and back-up supplies to chamber
6. Detach all hoses except that leading to chamber. Make sure chamber supply is completely shut off and no air is leaking to chamber, depleting the air supply.

K. Recompression Chamber Checkout (Pre-dive only)

1. Check that the chamber is completely free and clear of all combustible materials. This includes paint cans, refuse, matches, lighters, etc.
2. Check primary and back-up air supply to chamber as well as all pressure gages.
3. Check that the chamber is free of all odors or other contaminants.
4. Check the chamber oxygen supply, and that suitable numbers of oxygen masks are rigged for at least two divers, one tender, and one medical assistant.
5. Verify the presence of a sanitary bucket in the chamber in case of sickness.
6. Verify that the medical kit is completely outfitted and in the chamber
7. Check all doors and seals.
8. Verify that all chamber electrical fittings are fitted with armoured cable and special lighting fixtures and bulbs. All switches should be on the outside of the chamber.

L. Final Preparations

1. Verify that all necessary records, logs, and timesheets are on the diving station.
2. Check that appropriate decompression tables are readily at hand.
3. Verify that all air supply systems have a volume tank or accumulator installed in the air supply line between the supply source and the diver's hose connection. An oil separator must be installed between the tank and the connection.
4. Place the dressing bench in position, make sure that the diver will not have a long way to travel to reach the diving ladder or stage.

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NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022
Medical Deep Sea Diving Technician A-433-0020
Ship Salvage Diving Officer A-4N-0011
Deep Sea (HeO2) Diving Officer A-4N-0010

Security Clearance: Unclassified

Lesson Topic: 7.2 Mk V Deep Sea Diving System Diver

11 Hours

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual, Vol. I
Student Guide
Mk V Deep Sea Diving System
Materials for Projects:
- Angle Descent
- Tunneling
- Hogging Line
- Two Man Pontoon

TERMINAL OBJECTIVE

1. When the student completes this course he will be able to, as a diver, using a Mk V Deep Sea Diving System in open water at a depth of at least twenty feet, demonstrate increased proficiency in the use of the Mk V Deep Sea Diving System by successfully completing, in accordance with Diving Training Standards, any three of the following projects: Angle Descent, Tunneling, Hogging Line, and Two Man Pontoon.

ENABLING OBJECTIVES

1. Given a job analysis sheet on each project to be completed during this unit, orally EXPLAIN the following aspects of the projects:
   a. What the project is.
   b. The conditions under which the project is to be completed.
   c. Standards which will determine success.
   d. How to perform the project successfully.
   e. How each project relates to a fleet diving job.
   f. Particular skills necessary for successful completion of the project.

CRITERION TEST

1. As a diver, using a Mk V Deep Sea Diving System in open water at a depth of at least twenty feet, demonstrate increased proficiency in the use of the Mk V Deep Sea Diving System by successfully completing, in accordance with Diving Training Standards, any three of the following projects: Angle Descent, Tunneling, Hogging Line, and Two Man Pontoon.

HOMEWORK

Student Guide Volume G, Assignment Sheets 7-2-1A Job Sheets 7-2-1J through 7-2-5J.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction		
A. Establish Contact	Introduce Topic-Diver Instruction on weekly projects.	
B. Establish Readiness	Get students ready to learn. a. Tell story, or b. Brief background, or c. Situation.	
C. Establish Effect	Bring out the need and value of the material. a. Diving Skill.	
D. Overview	State learning objectives.	
II. Presentation		
A. Projects		
1. Use Diving Training Standards to explain each project to be completed.	Encourage students to look at the Two Man Pontoon on the surface--try them, if possible.	Questions as necessary.

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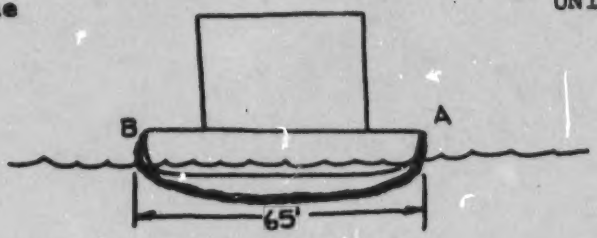
DIVING TRAINING STANDARDS

TASK. Hogging Line

UNIT: 1. Underwater Advanced



GENERAL DESCRIPTION: The diver will demonstrate his ability and proficiency with the Mk V Deep Sea Diving System by traveling a predetermined distance on a hogging line while maintaining the correct bouyancy conditions.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Water		
2. DEPTH	at least 20 feet		
3. EQUIPMENT	1. Mk V System		
4. OTHER	NONE		

(3)

STANDARDS:

1. PERFORMANCE	1. Maintain bouyancy, cross the distance and return.		
2. TIME	6 Minutes		
3. EQUIPMENT	NONE		

PROCEDURES:

1. Diver enters the water and adjusts the Mk V System to as near neutral bouyancy as he needs (as judged by student).
2. Swim to hogging line.
3. Beginning at Point A, proceed along hogging line hand-over-hand until diver reaches point B (see drawing).
4. Clear surface with helmet enough to make eye contact with instructor at point B.
5. Immediately return, in the same fashion, to point A.

WHY DO IT:

Gives the student the opportunity to increase his proficiency in attaining bouyancy in the Mk V Deep Sea Diving System.

SKILLS NEEDED:

Physical stamina
Proficiency in the use of:
- Air Control Valve
- Exhaust Valve
- Chin Button

SPECIAL INSTRUCTIONS:

1. Time starts when diver signals for tenders to give him slack and he is on the hogging line at Point A.
2. Time stops when the diver returns to Point A and can be seen by the instructor.
3. Students should be given a maximum of three trials at completing this project. Each time he should begin at Point A.

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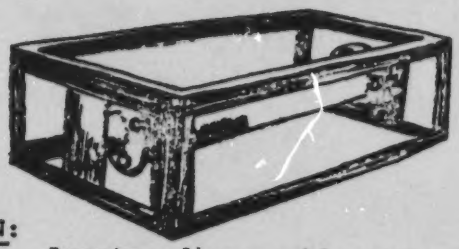
DIVING TRAINING STANDARDS

TASK: Two Man Flange

UNIT: 1. Underwater Advanced

2. SCUBA



GENERAL DESCRIPTION:

Locate, disassemble and reassemble a double flange by two divers.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open water	Open water	
2. DEPTH	at least 20 feet	at least 20 feet	
3. EQUIPMENT	1. Mk V System 2. Tool Bag 3. Wrenches	1. SCUBA gear & wet suit 2. Tool Bag 3. Wrenches	
4. OTHER	1. Murky water or blackened face plate		

STANDARDS:

1. PERFORMANCE	NONE	NONE	
2. TIME	27 Minutes	20 Minutes	
3. EQUIPMENT	Seven nuts & bolts are to be wrench tight	Seven nuts & bolts are to be wrench tight	

(5)

PROCEDURES:

1. Place project on bottom on project whip.
2. Divers (two) descend to bottom on project whip.
3. Each diver disassembles a flange and removes the rubber gasket.
4. Diver #1 requests a square mark.
5. Diver #1 attaches both gaskets to the square mark and sends them topside.
6. Recover gaskets.
7. Both divers replace gaskets and secure them with ten nuts and bolts.

WHY DO IT:

Teaches student divers team work while assembling/ disassembling pipe sections.

SPECIAL INSTRUCTIONS:

1. Time starts when both divers report on the bottom.
2. Time stops when diver #1 calls for project to be hoisted topside.
3. Instructor must insist on proper line-pull/ voice communication procedures during completion of the project.

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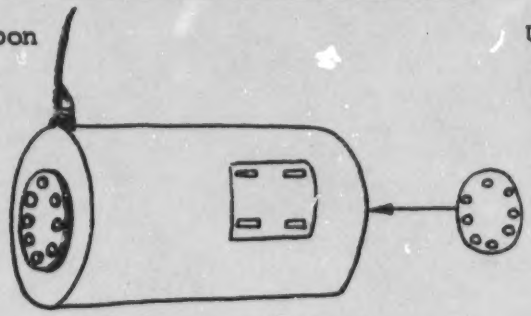
DIVING TRAINING STANDARDS

TASK: Two Man Pontoon

UNIT: 1. Underwater Advanced



GENERAL DESCRIPTION: Two divers remove and replace three patches on on a pontoon so that it may be floated.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Water		
2. DEPTH	at least 20 feet		
3. EQUIPMENT	1. Mk V System 2. Tool Bag 3. Wrenches		
4. OTHER	1. Murky water or blackened face plate		

(7)

STANDARDS:

1. PERFORMANCE	Use proper line-pull signals		
2. TIME	116 min. (50°+) 62 min. (50-)		
3. EQUIPMENT	Pontoon must float on surface for at least 3 minutes.		

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PROCEDURES:

1. Place project on the bottom on project whip.
2. Divers descend to bottom on the project whip.
3. Diver #1 removes "J" bolt patch, requests square mark, and sends the patch topside.
4. Diver #2 removes the large end patch and sends gasket topside on a square mark.
5. Diver #1 begins removing small end patch by reaching through "J" patch access.
6. Diver #2 enters the pontoon through the large end access and helps remove the small inside patch.
7. Once the patch is removed, Diver #2 removes gasket and gives it to Diver #1 (outside) who, in turn, sends it topside.
8. When the instructor sights the small gasket, he will immediately return all gaskets to Diver #1.
9. Small end gasket is given to Diver #2 (inside) for reassembly.
10. Diver #1 should begin replacing "J" bolt patch.
11. After installing inside patch, Diver #2 exits the pontoon and reassembles the outside large end patch.
12. When all patches are in place and tight, Diver #1 sends for an air hose and connects it to the pontoon.

(8)

WHY DO IT:

To give the student experience in working with other divers planning and actually working in the water.

SKILLS NEEDED:

Mechanical
Communication

SPECIAL INSTRUCTIONS:

1. Time starts when Diver #1 begins removing "J" bolt patch.
2. Time stops when air hose is connected.
3. If water temperature is below 50 degrees, time on project is decreased to 62 minutes. Do not remove/replace the inside (small end) patch.

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DIVING TRAINING STANDARDS

TASK: Angle Descent

UNIT: 1. Underwater Advanced

GENERAL DESCRIPTION: Diver descends to a descent line clump on on angle, pulls shackle down with a pennant, and secures shackle to descent line.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Water		
2. DEPTH	at least 20 feet		
3. EQUIPMENT	1. Mk V System		
4. OTHER	1. Murky water or blackened face plate		

STANDARDS:

1. PERFORMANCE	Use proper line-pull signals		
2. TIME	30 Minutes		
3. EQUIPMENT	Shackle must be secured to descent line so that it can be drawn up by topside personnel.		

(9)

PROCEDURES:

1. Diver makes himself slightly positive and swims to descent line.
2. Descend on descent line until diver reaches the bottom. Diver receives bitter end of shackle pennant prior to leaving the surface.
3. Back out on descent line until diver reaches clump.
4. When on the clump, spread feet apart, facing barge, and plant feet firmly. Diver makes himself heavy.
5. Pull in shackle pennant until diver receives shackle, laying all line received between legs. Do not move feet. Tenders will feed shackle on retreiving line.
6. When the diver receives shackle, he will remove the pin from the shackle and secure the shackle to the descent line.
7. Give proper signals for tenders to retreive shackle.
8. Diver returns to the surface after receiving word that shackle is on the surface.

WHY DO IT:

This project gives the student a realistic situation, and experience, in descending on an angle, which will often occur in open sea work.

(10)

SKILLS NEEDED:

Basic mechanical
Operation of the Mk V System

SPECIAL INSTRUCTIONS:

1. Time starts when diver leaves the surface on the descent line.
2. Time stops when diver signals to tender that the shackle is secured to the descent line.
3. Diver will get three trials at swimming to descent line.

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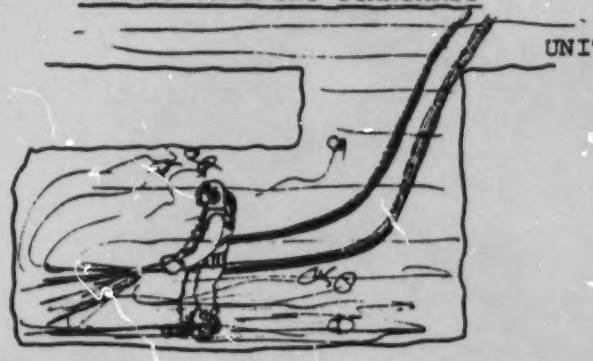
DIVING TRAINING STANDARDS

TASK: Tunneling

UNIT: 1. Underwater Advanced



GENERAL DESCRIPTION: Diver creates a hole ten feet deep and a tunnel thirty feet long in the bottom of a river/channel.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Water		
2. DEPTH	at least 20 feet		
3. EQUIPMENT	1. Mk V System 2. Excavating Nozzle and 2 1/2" water hose		
4. OTHER			

(11)

STANDARDS:

1. PERFORMANCE	Use proper line-pull signals		
2. TIME	15 Minutes		
3. EQUIPMENT	NONE		

PROCEDURES:

1. Diver descends to bottom on descent line. Nozzle to be secured to diver.
2. Upon arrival on bottom, put diver on searching signals and back him out twenty to thirty feet from diving platform.
3. Diver straddles hose and inserts his wrists into the loops secured to the nozzle.
4. Diver requests water pressure to the hose and begins to rotate the nozzle in a circular motion.
5. When diver completes the hole and tunnel, he requests topside to secure water pressure.
6. Diver buries nozzle into the bottom of the river/channel.
7. Diver returns to the surface.
8. Next diver descends to bottom using the water hose as a descent line.

WHY DO IT:

To give the student experience in the use of an excavating nozzle and hose in the underwater environment.

SKILLS NEEDED:

Physical stamina

SPECIAL INSTRUCTIONS:

1. Time starts when diver requests water pressure be turned on.
2. Time stops when diver requests water pressure be secured.
3. Instructor will observe churning in water and estimate distance achieved during time allowed.

(12)

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NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022
Medical Deep Sea Diving Technician A-433-0020
Ship Salvage Diving Officer A-4N-0011
Deep Sea (HeO2) Diving Officer A-4N-0010

Security Clearance: Unclassified

Lesson Topic: 7.3 Mk V Deep Sea Diving System Tender

10 Hours

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual, Vol. I
Student Guides
Mk V Deep Sea Diving System

TERMINAL OBJECTIVES

1. When the student completes this course he will be able to, as a member of a team tending a diver using a Mk V Deep Sea Diving System:
   a. Use correct line-pull and telephone communication procedures throughout all training guides.
   b. Dress a diver in a Mk V Deep Sea Diving System, within twelve minutes, so that he may safely enter the water.
   c. Demonstrate proper maintenance of the Diving Log and OPNAV Form 9940/1.

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ENABLING OBJECTIVES

This is a continuation of skills and knowledge developed during previous units.

CRITERION TESTS

1. As a member of a team tending a diver using a Mk V Deep Sea Diving System:
   a. Use correct line-pull and telephone communication procedures throughout all training dives.
   b. Dress a diver in a Mk V Deep Sea Diving System, within twelve minutes, so that he may enter the water safely.
   c. Demonstrate proper maintenance of the Diving Log and OPNAV Form 9940/1.

HOMEWORK

Student Guide Volume G, Assignment Sheets 7-3-1A.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction		
A. Establish Contact	Introduce topic-Tender instructions for the weekly diving evolutions.	
B. Establish Readiness	Get students ready to learn. a. Tell story or b. Brief background or c. Situation.	
C. Establish Effect	Bring out the need and value of the material.	
D. Overview	State the learning objectives.	
II. Presentation		
A. Line-Pull/Voice Communications. 1. Reiterate grading standards for each as necessary.	Emphasize that students will be scored on their performance.	Questions about grading or communication procedures as necessary.
B. Dressing the Diver		
1. Time limit-12 minutes. 2. Standards-so that he may safely enter the water.	Emphasize that this will be a team (2 man) timed and graded evolution.	Questions as necessary.
C. Log Maintenance 1. Includes Diving Log and OPNAV Form 9940/1.	Emphasize that this will be a graded evolution.	Questions concerning Diving Logs as necessary.

NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022
Medical Deep Sea Diving Technician A-433-0020
Ship Salvage Diving Officer A-4N-0011
Deep Sea (HeO2) Diving Officer A-4N-0010

Security Clearance: Unclassified

Lesson Topic: 8.1.2 Lightweight Diving System Diver
8.2.2 Lightweight Diving System

15 Hours

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual, Vol. I
Student Guides
Standard Classroom Material
Chart/Transparency of Mk I Mask
Mk I Mask and associated equipment
Hot Water Suit
Clayton Diving Heater System
Chafing Gear

TERMINAL OBJECTIVES

1. When the student completes this course he will be able to, as a diver, perform the following functions:
   a. In an open tank, with a minimum of eight feet fo water, using the Mk I Mask, demonstrate emergency air change-over procedures.
   b. In open water, at a minimum depth of twenty feet, using the Mk I Mask and Hot Water Suit, complete the Searching Project in accordance with Diving Training Standards.

2. When the student completes this course he will be able to, given the Planned Maintenance System (PMS) requirements for the Mk I Mask, correctly perform the necessary maintenance.

ENABLING OBJECTIVES

1. Orally explain the procedures for dressing a diver using the Mk I Mask.

2. Describe, orally, the prevailing conditions (including indications received by the diver) which would prompt a diver using the Mk I Mask to use the procedures for emergency air change-over.

3. Demonstrate correct procedures for emergency air change-over, using the Mk I Mask System.

4. Explain, orally, the Searching Project, in accordance with Diving Training Standards, to include standards, how to perform the project, and particular skills needed for successful completion of the project.

ENABLING OBJECTIVES (cont'd)

5. Orally explain the function(s) of the major components in terms of what they do for the system.

6. Given a standard print of the Mk I Mask, describe, by labeling, the physical location of the major components and their component parts.

7. Orally describe the sources of power for communications used with the Mk I Mask System.

8. Demonstrate and orally describe the modes of control for the side valve and second state dial-a-breath.

9. List, in writing, the ratings for the umbilical and emergency bottle assembly.

10. Describe, in writing, the major materials use, explaining why, for the major components and their component parts.

11. Orally explain the function(s) of the component parts in terms of what they do for the components.

12. Explain, orally, how the component parts carry out their function(s).

13. Demonstrate and orally describe the modes of operation and the flow path

ENABLING OBJECTIVES (cont'd)

of the breathing media through the Mk I Mask, in each mode.

14. State, in writing, the maximum depth without come home bottle, without open bell, and diving on air using the Mk I Mask, and reasons for these maximums.

15. Orally describe the effect on this Mk I Mask System due to the umbilical, emergency bottle assembly, diving heater system, open diving bell system and breathing media source.

16. Explain, orally, the unique safety precautions of using on 120 VAC for recharging battery if amplifier is equipped with a rechargeable battery.

CRITERION TESTS

1. In an open tank, with a minimum of eight feet of water, using the Mk I Mask, demonstrate emergency air change-over procedures.

2. In open water, at a minimum depth of twenty feet, using the Mk I Mask and Hot Water Suit, complete the Searching Project in accordance with Diving Training Standards.

CRITERION TESTS (cont'd)

3. Given the PMS requirements for the Mk I Mask System, correctly perform the necessary maintenance.

HOMEWORK

Volume H, Student Guide, Assignment Sheets 8-2-4A through 8-2-8A; Job Sheets 8-1-3J through 8-1-6J.

1617

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction to the lesson.		
A. Establish contact.	Introduce self and topic.	
B. Establish readiness.	Get students ready to learn.	
C. Establish effect.	Bring out need and value of material being presented.	
D. Overview.	State learning objectives. Terminal and Enabling	
II. Presentation		
A. Background		
1. Mk I Dive Mask is the ninth generation of a commercial divers face mask system designed by Bev Morgan and U.S. Divers Co.		
2. The system was recently (1975) used to establish the world's open sea dive record at a depth of 1148 feet. (Experimental Diving Unit personnel, Panama City, Florida)		
3. The Mk I Mask was designed to provide the diver with extremely comfortable		

and durable life support and communication systems.

4. Unlike the Jack Browne Dive Mask, the Mk I Mask is so designed so as to eliminate the possibility of face squeeze. Explain.

5. Depth Limitations for air.
   a. Maximum--190'.
   b. Below 130'--use of an Open Diving Bell is mandatory.
   c. Below 60'--a come home bottle is mandatory.
   d. Depths may be further restricted by:
      (1) Bendix filter.
      (2) Activity Air Supply.

6. KMB 8 & 10 require a side block Retrofit and <u>will</u> <u>not</u> be used for diving.
   a. KMB's 8 & 10 will be called into a central location for retrofit in

1650

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the future. (Ref. NAVSEACOM ltr, Nov. 1975, ser. #1526).

7. Those KMB-9 fixed and serialized by NAVSEA are the only version of the KMB series authorized for use in air diving.

a. This mask will have a designation of Mk I, Mod T.

b. Two other versions of the KMB.

(1) Mk I, Mod O--MILSPEC Procurement issue in Spring, 1976.

(2) Mk I, Mod S--Battelle Saturation System Retrofit.

B. Mask Assembly

Follow on page 21 of KMB-9 Manual.

1. Frame (main body).

a. Fabricated of a non-corrosive rigid plastic (cycolac).

Why would we make it out of plastic?

(1) Cycolac will not carry an electrical charge.

Pilots and motorcycle helmets, lawn mower bodies etc.

b. Function: Supports the seven basic

parts.

(1) Face port.

(2) Side valve assembly.

(3) Demand regulator (second stage).

(4) Main exhaust assembly.

(5) Hood and face seal.

(6) Communications.

(7) Oral-Nasal mask.

Note: Each item will be discussed separately.

2. Lens "O" Ring. What is an "O" Ring?

a. Fabricated of a rolled rubber.

b. Function: to form a watertight seal for the face port.

c. "O" Ring has a tight fit.

3. Face Port.

a. Fabricated of 1/4" acrylic plastic. Why use plastic vice glass? With heat treatment glass could still shatter.

b. Scratches easily.

c. Never Dull or scouring powder paste

1654

1655

will remove most scratches.

d. Not reversible. Explain. One side is flat.

e. Function.

(1) Vision for the diver.

(2) Wide non-distorted field of vision.

4. Port Retainer What is a port retainer? Why are the parts on the KMB mask chrome plated? Easy to keep clean and maintained.

a. Chrome plated brass.

b. Secured with 15 chrome plated brass screws.

c. Functions.

(1) Secures face port and "O" Ring in place.

(2) Maintains pressure on the "O" Ring for a watertight seal.

(3) Supports the nose clearing device.

5. Nose Clearing Device. Why have a nose clearing device?

a. Chrome plated brass.

b. Attached to the bottom of the port retainer.

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c. Padded rod that protrudes through the frame (main body) into the oral-nasal mask.

d. Padded with neoprene rubber.

e. May be bent to fit the nose better.

f. When donning mask always pull out on the nose clearing device.

g. Should use the lips in conjunction with clearing device for better seal.

h. Function: to assist the diver in equalizing his middle ear.

i. Three "O" Rings and a nut form the watertight seal around the stem.

(1) One "O" Ring goes on before the port retainer.

1659

6. Main Exhaust.

a. Located at the bottom of the frame (main body) under the second stage Point out.

1658

regulator.

b. To purge water from the main cavity of the mask. Explain.

c. Main Exhaust valve. Point out.

(1) Fabricated of rubber.

(2) One way check valve (non-return).

(3) Seat for the valve is molded in the main body. Point out.

d. Exhaust cover is fabricated of a chrome plated metal.

e. Removal of this cover permits access to the exhaust valve.

f. Cover channels exhaust back away from the diver's face.

g. Cover is secured in place by two chrome plated brass screws.

7. Communication Posts.

a. Located on bottom right hand side of the frame.

1441

b. Components that make up the communication posts.

(1) Two communication posts.

(2) Two washers.

(3) Four nuts.

c. Connectors for head phones and mike.

d. Connections for waterproof connectors (marsh marine fitting). (Marsh marine fitting will be discussed later in the lesson.)

8. Side Valve Assembly.

a. Located upper right hand side of the frame.

b. Bypass manifold for the emergency gas supply, gas for steady flow valve and supply to second stage regulator.

c. Contains the on/off valve to gas supply to the inside of the mask.

d. Contains three connections.

1663

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(1) Regulator hose assembly.

(2) One-way valve body.

(3) Emergency supply valve.

e. Contains an unobstructed passage for the gas supply through the center of the side valve body for all modes of operation. Illustrate on C/B

9. Side Valve Body

a. Upper section of the side valve assembly.

b. Contains gas passages for all modes of operation.

c. Attachment for three threaded fittings.

(1) Regulator hose assembly.

(2) One-way valve body.

(3) Emergency supply valve.

d. Contains on/off valve for the steady flow system.

e. Securing device for the muffler and

1446

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deflector.

f. Two threaded fittings secure side valve body to the frame.

g. Side valve body is held in place with two bolts.

h. Fabricated of a corrosion resistent steel.

i. All connections are made of chrome plated brass.

10. Gasket.

a. Located between side valve body and the frame.

b. Forms a watertight seal between side valve body and the frame.

c. Fabricated of 1/16" neoprene rubber.

11. Muffler Sponge.

a. Inside of mask on the right hand side.

b. Synthetic sponge.

c. Traps moisture.

1687

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d. Muffles noise.

12. Deflector. Why have air deflected across face port?

a. Cover for the muffler sponge.

b. Chrome plated brass.

c. Contains six deflection holes and one securing hole.

d. Deflects air across face port.

13. Regulator Hose Assembly. Refer to drawing or chart.

a. First connection on side valve body.

b. Rubber hose with chrome plated brass fittings.

c. L.P. Hose.

d. Supplies L.P. air to the second stage regulator. Explain.

14. One-way Valve Body.

a. Middle connection on the side valve body.

b. Chrome plated brass.

c. Double male fitting.

1669

(1) 1/4" pipe into side valve body.

(2) 9/16"-18 male O2 fitting for umbilical connection.

d. Contains seat for one-way valve (non-return).

15. One-way Valve (non-return).

a. Located inside the one-way valve body.

b. Made by Kepner Prod. Co.

c. Made of brass.

d. Poppet type valve.

e. Discard unit if it will not pass functional test.

f. Direction of flow arrow stamped on the outside of valve.

g. Tested prior to each days diving. Explain.

h. Procedure for testing.

1671

(1) Do not attach the umbilical.

(2) Connect up the emergency air supply valve.

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(3) Secure steady flow valve.

(4) Open emergency supply valve.

(5) Check for leaks at the umbilical connection.

16. Emergency Air Supply Valve.

a. Last connection on the side valve body.

b. Chrome plated brass valve.

c. On/off valve for emergency air supply.

d. Hookup for the emergency 71.2 cu ft bail out bottle.

e. Drilled out to 3/8" ID to receive the hose from the first stage regulator.

17. Demand Regulator.

a. Modified ConshelfXII.

b. Modified to contain the dial-a-breath.

c. Located on the front of the frame below the face port.

d. Chrome plated brass casings.

e. CRS springs.

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f. Diaphragm made of rubber.

g. Rubber one-way valve.

h. Rubber exhaust channel.

i. Supplies the diver with the breathing media while on the demand mode during the inhalation cycle. Explain.

j. Supplies diver with steady flow of air when required using the dial-a-breath.

k. Secondary exhaust.

l. Contains a second means of clearing a flooded mask or a small amount of water from the mask.

18. Operation of Conshelf XII

a. Supplied with air from the side valve body.

b. While in primary or emergency mode. Explain.

c. Air flows through the L.P. Hose to the second stage regulator.

1675

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d. Air is checked at the second stage regulator by the disc and retainer.

e. As diver inhales, the diaphragm is drawn against the lever (called a horseshoe).

(1) This action retracts the disc and retainer from the inlet nipple.

(2) The inlet nipple contains the seat for the disc and retainer.

(3) Retracting the disc and retainer allows air to flow to the interior of the regulator.

(4) Air is then inhaled by the diver.

(5) Air is then exhaled back into the regulator and out the secondary exhaust.

What does secondary exhaust prevent? CO2 build up.

f. Supplied with two standard springs.

(1) Light spring is located on the

inlet side.

(2) Heavy spring is located in the dial-a-breath.

Note: Spring and piston and spacer will be replaced in the near future. Two springs will be added in place of the spring.

g. Both springs exert a force which tend to hold disc and retainer closed.

(1) Spring tension varies by the use of the dial-a-breath.

(2) Turning in increases tension.

(3) Backing out releases tension. Explain.

h. If dial-a-breath is secured air will still flow to the diver. Explain. KMB-8.

i. With both standard springs in, the regulator will handle a range of inlet pressures up to 180 psi.

1679

j. Ideal for surface supply pressures of 150-180 psi. Explain.

1678

k. Higher pressure range can be arrived

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

at by changing the spring on the inlet side to a heavier spring.

(1) Same spring that is on the dial-a-breath side 180-300 psi.

l. Purge button is located in the center of the second stage regulator.

m. Purge button is a manual over ride for the springs. Explain.

n. Exhaust port is located on the bottom of the regulator.

(1) Made of hard rubber.

(2) Secondary exhaust.

(3) Channels bubbles away from diver's face. Explain.

19. Oral-Nasal Mask.

a. Oral-nasal mask is located inside of the frame.

(1) Attached to the second stage regulator.

(2) Reduces dead air space in the main cavity of the mask.

(3) Prevents CO2 build up.

(4) Air is inhaled from second stage regulator into oral-nasal mask.

(5) Exhaled back into the oral-nasal mask.

(6) Out through the secondary exhaust port of the regulator.

b. Contains microphone for communications.

c. Contains a one-way rubber check valve.

(1) Air from steady flow valve flows into the main part of the mask.

(2) Through the one-way valve into the oral-nasal mask.

(3) On exhalation cycle exhaled gas seals one-way valve.

(4) Exhaled gas exhausts out the secondary exhaust.

1693

1692

(5) All other air is expelled out the main exhaust.

20. Communications.

a. Microphone is located in the oral-nasal mask.

b. Right and left headphones are located in the hood pockets in their respective places.

c. Components of system.

(1) Two earphones.

(2) Microphone.

(3) Two communication posts.

(4) Washers (two).

(5) Nuts (four).

(6) Packing gland.

(7) "O" Ring.

(8) Waterproof connector.

d. Waterproof connector is a four terminal connector. Explain.

e. Marsh marine fitting.

(1) 4 pin connector.

(2) Shielded neoprene rubber covered bronco cable.

(3) 4 cable no. 16 wire.

f. Normally only two wires are used.

g. Spare wires hooked up along side the other two (this keeps them out of the way).

h. Spare wires are used for a back up set.

i. Spare wires can be used for a more complex system.

j. Marsh marine fittings are the primary waterproof connectors used.

k. Communications can be hooked up with bare wire connections. Explain.

1. Bare wire connectors produce a slight loss of signal.

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OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

m. Male fitting on diver's mask.

n. Female on the umbilical end.

o. Wires go through a packing gland that in secured into the main frame.

p. Packing Gland and "O" Rings form the watertight seal.

q. Wires are hooked up to communication posts.

r. Topside are bare wire or bannana plugs to communication box.

s. Earphones are bone conductors.

21. Hood and Face Seal.

a. Fabricated from neoprene rubber and open cell foam.

b. Open cell foam forms a comfortable cushion that pushes the sealing surface of the neoprene against the diver's face.

1698

c. Open cell foam will not compress

1699

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with pressure.

d. Hood contains built in pockets which are open to the interior of the mask.

(1) Pockets retain the earphones.

(2) Air from the mask equalize the old type earphones.

(3) Heli earphones and mikes are completely sealed and do not require equalization.

e. Hoods have a zipper installed for ease of donning.

22. Retainer Bands.

a. Two bands.

b. Fit around the hood and face seal combination.

c. Holds hood and face seal to the frame.

d. Two screws hold the bands together.

1691

e. Five spider hooks. Explain.

f. Chrome plated brass balls.

1690

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(1) Small rods standing on the retainer band hold the balls in place.	Explain.	
23. Head Harness Spider.		
a. Five straps.		
b. Made of rubber.		
c. Used to secure the mask to the diver's head.		
24. Emergency Bottle.		
a. A bottle of compressed gas corresponding to the breathing mixture being used on the dive.		
b. If main gas supply fails diver can utilize this bail out system.		
c. Standard 71.2 cu ft bottle is used. (referred to as a 72 cu ft).		
d. Bail out bottles are not required up to 60'.	Note: Required to use bail out bottle inside submarine ballast tanks and wrecks.	
e. Bail out bottle is required 60' and		

1692

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below.

f. The standard backpack for a single 72 cu ft bottle is used.

25. First stage regulator.

a. First stage regulator from a Conshelf XII single hose regulator

b. Regulator is set at 125 psig.

c. Safety valve in the low pressure side will release at 200 psi. Explain.

d. Safety feature. Explain.

26. Umbilical.

a. Gas supply hose. NAVSEA System

(1) Hewitt-Robbins, Inc. NO-23-0152. Letter 1526 Nov. 1975

(2) Gates-Rubber No 6C3 or equivalent in size.

(3) One continuous length.

b. 3/8" ID, 3/4" OD. 1695

c. Smooth bore.

d. 9/16" by 18.

1694

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
e. Minimum working pressure 800 psig.	Explain.	
27. Flow path of gas.		
a. Primary mode.		
(1) Air supply from topside.		
(2) Comes through umbilical.		
(3) Into the one-way valve body.		
(4) Passes through the one-way valve (non-return).		
(5) Into the side valve body.		
(6) Passes through the regulator low pressure hose.		
(7) Then into the second stage regulator.		
(8) Into the oral-nasal mask.		
(9) CO2 exhausts out secondary exhaust.		
b. On the primary mode the steady flow on/off valve is secured.		
c. Emergency supply valve is in the closed position.		
d. Bail out bottle open.	Explain.	

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28. Emergency Mode.

a. Air from 71.2 cu ft bail out bottle.

b. Through first stage regulator and hose.

c. To the emergency supply on/off valve.

d. Through the side valve body (air to both steady flow valve and second stage regulator).

e. Into the low pressure regulator hose.

f. To the second stage regulator.

g. Into the oral-nasal mask.

h. Exhaust out secondary exhaust.

i. Steady flow system is a emergency mode.

j. May be operated on surface supplied mode (primary mode). Explain.

1699

k. Steady flow used for:

(1) Clearing face port (CO_2 build up).

(2) Clearing flooded mask.

1698

1. Going on emergency mode.

(1) Notify topside.

(2) Stop all work.

(3) Standby for instructions.

C. Preventive Maintenance

1. Minimum maintenance.

a. Depends on the type water.

b. Type of job.

2. Daily maintenance.

a. Visually inspect both interior and exterior.

b. Face seal saturated with water-squeeze out.

c. If mask is not to be used any more that day remove hood and face seal.

d. Remove any dirt or sand from the interior of the mask.

(1) Keep from scratching face port.

1700

e. Check all moving parts.

1701

1464

(1) Emergency supply valve handle.

(2) Dial-a-breath.

(3) Nose clearing device.

(4) Non-return valve.

(5) Steady flow valve.

f. Communications System.

(1) Mike and earphones.

(2) Communication posts.

(3) Bare wire connector.

3. Monthly (or between jobs).

a. Inspect hood and face seal for tears.

b. Inspect spider for tears.

c. Inspect and test:

(1) Earphones.

(2) Microphone.

(3) Wire connectors.

d. Remove muffler and deflector assembly.

1703

e. Remove nose clearing device.

1702

(1) Lubricate shaft.

(2) Lubricate "O" Rings. Use Flor-a lube.

f. Lubricate main exhaust valve.

g. Remove exhaust tube.

(1) Lubricate second stage regulator exhaust valve.

h. Remove second stage regulator clamp.

(1) Remove cover assembly.

(2) Unscrew handle.

(3) Drop out spacer, spring and piston. Clean, lubricate, and reassemble.

III. Summary and Questions

Ask questions as necessary.

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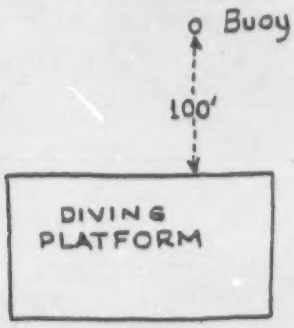
DIVING TRAINING STANDARDS

TASK: Searching

UNIT: 1. Underwater Basic

2. Lightweight Diving



GENERAL DESCRIPTION: Diver responds correctly to searching line-pull signals by moving in direction indicated by diving tenders.

CONDITIONS:	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Water	Open Water	
2. DEPTH	at least 20 feet	at least 20 feet	
3. EQUIPMENT	Mk V Deep Sea Diving System	Mk I Mask and Hot Water Suit	
4. OTHER	Murky water or with faceplate blacked out	Murky water or with faceplate blacked out	

STANDARDS:			
1. PERFORMANCE	Correctly respond to all searching line-pull signals	Correctly respond to all searching line-pull signals.	
2. TIME	30 Minutes	30 Minutes	
3. EQUIPMENT	Submerge portable buoy two times by hand pulls while standing on the bottom	Submerge portable buoy two times by hand pulls while standing on the bottom	

(33)

PROCEDURES:

1. Diver descends to bottom.
2. Diver reports on bottom and ready to go on searching pattern.
3. After the project is complete, use proper line-pull communications and come to surface.

WHY DO IT:

To give the student experience and training in techniques of finding objects on the bottom in dark water.

SKILLS NEEDED:

Sense of direction
Nominal proficiency in Mk V Deep Sea Diving System

SPECIAL INSTRUCTIONS:

1. Diver should be allowed a maximum of three minutes to become oriented on the bottom before beginning searching pattern.

NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022
Medical Deep Sea Diving Technician A-433-0020
Ship Salvage Diving Officer A-4N-0011
Deep Sea (HeO2) Diving Officer A-4N-0010

Security Clearance: Unclassified

Lesson Topic: 8.2.3 Lightweight Diving System (Open Diving Bell)

1 Hour

INSTRUCTIONAL MATERIALS

U.S. Navy Diving Manual, Vol. I
Student Guides
Standard Classroom Equipment
Chart/Transparency of Open Diving Bell

TERMINAL OBJECTIVE

1. When the student completes this course, he will be able to, given the Planned Maintenance System (PMS) requirements for the Lightweight Diving System (including Open Diving Bell), correctly perform the necessary maintenance.

ENABLING OBJECTIVES

1. Orally explain the function(s) of the major components and their component parts.

2. Given an illustration of a typical Open Diving Bell, locate, by labling, the major components.

3. Explain, in writing, how the major components carry out their function(s).

4. List, in writing, the major materials used in constructing an open diving bell and explain why.

5. Orally describe the flow path of the breathing media through the system and the pressurization of the hull body.

6. Orally explain the safety aspects of maintaining the bell in an upright position during operation.

CRITERION TEST

None at present due to limited equipment.

HOMEWORK

Student Guide, Volume H, Assignment Sheet 8-2-9A and 8-2-10A

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction		
A. Establist Contact	Introduce self and topic.	
B. Establish Readiness	Get students ready to learn.	
C. Establish Effect	Bring out need and value of lesson.	
D. Overview	State Learning Objectives	
II. Presentation		
A. General Description		Take notes as necessary
1. The Diving Bell is comprised of five subsystems.		
a. Structural		
b. Acrylic Dome		
c. Gas		
d. Communications		
e. Ballast		
2. The bell is used as a transfer stage and diver's refuge for divers working from the surface to a maximum of 300 feet.		

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a. Provides a semi-dry environment and allows diver removal of diver's hats.

b. Designed for shipboard use where a communication system, source of breathing media (either gas or air), and a crane for handling are available.

c. Has its own umbilical connections for gas and communication lines.

(1) Compatible with standard Navy umbilical.

B. Description of Assemblies

1. Structure: The bell has four major weldments.

a. Frame structure (main structural weldment).

b. Skirt weldment

(1) Gas, communications system and dome are mounted on skirt weldment.

c. Deck weldment (platform for divers)

d. Ballast trays (space for lead weights below deck)

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY STUDENT ACTIVITY
2. Acrylic Dome	
a. Formed from a sheet of 1/2" acrylic plastic.	
b. Partially enclosed refuge for diver.	
c. Minimum obstruction to visibility.	Use chart, transparency or or draw on C/B
3. Gas System	Breathing gas passes through a skirt penetrator and is dis-
a. Three modules attached to interior of skirt.	/tributed through 1/2" copper tube.
(1) Right dewater and mask.	
(2) Left dewater and mask.	
(3) Center master valve and mask with pressure gauge.	
b. Four vents in lower portion of skirt.	Show on Chart or C/B
(1) Expelled gas is carried to the exterior apex of the bell dome.	
4. Communications	
a. Waterproof speaker with interconnecting wiring to a communication connection on	Use chart, transparency or draw on C/B

the exterior of the skirt.

b. Speaker mounted on upper skirt ring.

c. All bell wiring encased in copper tubing and fittings.

d. Vent line from speaker to top of dome for pressure equalization.

5. Ballast

a. 24 lead bars with handles.

b. Approximately 130 lbs each

c. Hole in one end for securing bolt

d. Any number can be used to establish a desired ballast condition.

Bell shipped in crate as a complete unit including flashlights and chargers.

C. Inspection and Adjustment

1. Upon receiving the bell and before each dive:

a. An initial check of the bell should be made to insure that no major structural damage has occured. Special

attention should be given to inspecting for damage to the dome.

b. With the bell gas and communication systems connected, set gas pressure at 235 psi and turn on the communication system.

c. Enter the bell and check all valves and the oral/nasal masks to be certain that they are operating properly. The dewatering valves and mask valves should be opened one at a time. When each mask valve is opened the appropriate mask should be tested for adequate flow.

d. Check the communication system to be certain that there is clear two way communication between the surface and the bell.

2. After extended periods of storage or shipment:

a. The bell should be manned by a diver and put in the water. Lower the bell until the top

of the dome is about one foot below the water.

b. Fill the dome completely with air and with the venting gas turned off check the flange area visually for leaks.

c. With the bell back on deck, remove the non-return valve on the bell exterior and test to be certain it will not pass flow against the check.

d. Inspect the porous filters for excessive corrosion. Remove them to be certain they will pass gas freely. If they are blocked, they should be replaced.

D. Functional Operation

1. The bell is connected to a source of breathing media and a topside diver intercommunication system. The interconnections are made with a standard Navy umbilical. A crane is used to handle the bell while on

deck and in the water. The bell can transport two divers to and from a work site, providing them with a breathing media and communication with the surface.

E. Support Equipment and Services

1. Clear working area on deck.
2. A crane (5 ton capacity)
3. Standard Navy umbilical for communication and gas supply.
4. Tag lines for handling bell.
5. Shackles, turnbuckles, and chains for moving bell with crane and making bell fast to deck when not in use.

Precaution: Overside clearance of 10 feet necessary for handling.

F. Preparation for use

1. Attach tag lines for handling.
2. Move bell to dive station and remove hercu-lite cover.
3. Attach the umbilical to bell (both gas and communications)

a. Set gas pressure 100 psi over bottom pressure.

4. Tie umbilical to lifting frame to prevent strain on connections.

C. Operating Procedures

1. Bell dewater systems

a. Operated by a central valve (DWV-1) and two valves below the porous filters (DWV-2 and DWV-3).

b. With end valves open, the system can be operated by the central valve alone.

c. If the central valve is open the two end valves will operate the dewater system independently.

d. As the bell is descending the dewater system can be operated to keep the water level below the lower ring.

(1) On ascents it will help eliminate fogging in the dome.

e. While the bell is at the working depth, if the divers are breathing the bell atmosphere, the dewater system should be opened slightly to allow a low velocity flow to continuously enter the bell.

f. When the bell communication system is being used, this system should be turned off to eliminate excess noise.

g. Whenever the dewater system has been off for a period of time, (approximately one minute), it should be turned on again with a high velocity flow for purging the bell.

2. Ballast

a. All 24 ballast bars in place give a negative buoyancy of 1500 lbs.

b. 125 lb negative buoyancy each bar.

c. Adjust from 1500 lbs positive to 1500

lbs negative as desired for operation.

3. Handling

a. Lifting at top of main structural major lifting point weldment.

(1) Launch weight approximately 4,300 lbs.

b. Four padeyes near deck for tag lines for handling launching and recovery of bell.

c. After entering water, bell attached to descending line.

(1) guides to work site

(2) prevents movement from currents

(3) prevents rotation

4. Ascent and Descent

a. Maximum ascent rate - 60 fpm

b. Maximum descent rate - 75 fpm

c. Use descending line whenever possible.

5. Oral Nasal Masks

Use chart, transparency, or draw on C/B
Scott Aviational Nasal Mask

a. For emergency breathing.

b. Individual Supply lines (MV-1, MV-2, MV-3)

c. When in use, central gas valve is open, the individual control valves for each mask are used to pressurize the mask.

6. Tool Rack and Lights

a. Tool rack for small tools and parts.

b. Large tools secured to deck or to hook provided on skirt exterior.

c. Two hand held diver's lights secured.

7. Post Dive Maintenance

a. After each dive, the bell should be thoroughly washed down with fresh water inside and out.

b. The oral nasal masks should be blown dry and removed for storage in a dry area.

c. The diver's lights should be removed and placed on chargers.

d. The gas system should be blown out.

e. Replace Herculite cover.

8. Bell Maintenance - the bell has been designed to be as maintenance free as possible. Maintenance will be required on the following items:

a. Bolts: All bolts should be inspected on a regular basis to assure a secure attachment.

(1) Dome hold down bolts are particularly critical and should be checked every two days during regular operations.

(2) The hold down bolts should be torqued to 25 ft lbs.

b. Dome: If desired, small scuff marks can be removed by polishing with a buffing wheel and a polish such as DuPont No.7 Auto Polish and Cleaner.

(1) Attempts to polish larger scratches will create a thin spot in the acrylic.

(2) If any cracks appear in the dome, replace the dome.

c. Painting as required to alleviate rust problems - particularly areas of ballast trays and lift eye.

(1) Touch up consisting of light sanding and then a coat of Amercoat #35.

d. Mufflers: The porous mufflers in the de-watering systems should be checked on a regular basis for corrosion.

(1) Once a week, during regular use of the bell, the porous filter mufflers should be removed and then attached to the end of an air hose and placed in water with a low pressure flow through them.

(2) If the muffler is clean it will bubble freely, if it does not, the muffler should be replaced.

e. Check Valves: The gas system has three check valves.

(1) The Main Check Valve on the exterior

of the skirt should be removed and pressurized in the opposite direction and then inserted in water to be certain that the flow is checked by the valves.

f. Vent Tubes: All vent tubes should be securely attached and free from sharp bends.

(1) The plug at the top end of the speaker vent should be inspected each week to assure free flow.

g. Speaker: The speaker should be opened once a week during regular operations to check for water accummulation in the base.

(1) If the gasket on the front plate dries out or cracks, it should be replaced.

III. Summary

A. Hull Body (upper structure).

1. Umbilical connections

2. Lifting Padeye.

3. Dome

4. Ballast Platform.

B. Built-in Breathing System Manifold

1. Supply Valve

2. Vent Valve

3. Demmo Regulator Outlets

4. SCUBA Regulator

C. Communications

1. Diver's Reproducer

2. Male Telephone Connection.

D. Umbilical

1. Standard Deep Sea Hose

2. Air Hose Fittings

3. Lifeline/Telephone Cable

4. Pneumo Hose

5. Seizing Studs

6. Hose Cover

7. Lowering/Retrieving Line

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NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022
Medical Deep Sea Diving Technician A-433-0020
Ship Salvage Diving Officer A-4N-0011
Deep Sea (Hard) Diving Officer A-4N-0010

Security Clearance: Unclassified

Lesson Topic: 8.2.4 Hot Water Suit

2 Hours

INSTRUCTIONAL MATERIAL

U.S. Navy Diving Manual, Volume I
Student Guides
Standard Classroom Material
Hot Water Suit

TERMINAL OBJECTIVES

1. When the student completes this course he will be able to, given the Planned Maintenance System (PMS) requriements for the Hot Water Suit, correctly perform the necessary maintenance.

ENABLING OBJECTIVES

1. Orally explain the function(s) of the major components in terms of what they do for the system.

2. Given a standard print of the Hot Water Suit, describe, by labeling, the physical location of the major components and their component parts.

3. Demonstrate the operation of the velcro strips.

ENABLING OBJECTIVES (Cont'd)

4. List, in writing, the rating(s) of the tubing within the Hot Water Suit.

5. List, in writing, the major materials used in the major components and their component parts and explain why.

6. Orally explain the function(s) of the component parts in terms of what they do for the components.

7. Orally explain how the component parts carry out their function(s).

8. Demonstrate how and where the control function is accomplished.

9. Orally describe the effect on the Hot Water Suit due to the Clayton Diving Heater System and the Mk I Mask System.

CRITERION TEST

1. Given the Planned Maintenance System (PMS) requirements for the Hot Water Suit, correctly perform the required maintenance.

HOMEWORK

Volume H, Student Guide, Assignment Sheet 8-2-11A.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. INTRODUCTION		
A. Establish Contact	Introduce self and topic.	
B. Establish Readiness	Get students ready to learn. Classroom procedures.	
C. Establish Effect	Bring out need and value of material.	
D. Overview	State Learning Objectives	
II. Presentation		
A. Introduction to Hot Water Suit	Use actual equipment, transparency or chart to show during discussion.	Observe and take notes as necessary.
1. A new concept of diving, used by Saturation Divers, but will soon be used by all divers in the fleet.		
2. Allows divers to enter colder water with longer bottom times.		
3. Advantages		
a. Divers stay more alert.		
b. More effective performance.		
c. Need not worry about getting cold and not being able to finish the job.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
4. Usage		
a. Mk I Mask		
b. Clayton (or similar) Diving Heater.		
B. Construction	Use actual equipment, transparency or chart.	
1. Nylon covered		
a. 1/4" thick		
b. On both sides for strength.		
c. Loose fitting		
(1) Lets water circulate to keep diver warmer.		
2. Hood		
a. Built into suit.		
b. Difficult to get seal when using the Mk I Mask.	Explain: Because of double hood.	
c. Can be modified in order to use Mk I Mask.		
3. Hot Water Tubing		
a. Cemented inside of suit.		
(1) 1/4" ID X 1/16" wall thickness		

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b. Tubing has Neoprene Covering

(1) Holes in the tubing are out of the side of the tubing.

(a) creates better water circulation.

4. Zippers

a. Made of Nickel Silver

(1) Corrosion Resistant

b. On front and down legs of suit.

5. Neoprene Gloves

a. Elbow Length

(1) Tubing on the suit extends 6" to 8" below arms of suit.

(2) Tucked down inside of the gloves to provide hot water to hands.

b. Glove Hand

(1) Made of 1/16" material for flexibility.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

6. Neoprene Boots

   a. Knee Length

      (1) Tubing extends 6" to 8" below the legs on suit.

      (2) Tucked down inside of boots to provide hot water for the feet.

7. VELCRO Strips

   a. Velcro hook is sewn on outside of the arms and legs. — Show hooks and piles

   b. Velcro pile is sewn inside of gloves and boots to match the velcro hooks.

      (1) The hooks and piles prevent gloves and boots from slipping off and loosing hot water.

8. Hot Water Control Valve Manifold — Use actual equipment, transparency or chart.

   a. Main body is made of pol/vinyl Chloride (PVC).

      (1) Non-corrosive in saltwater

b. Hot water tubing connectors are made of brass.

(1) Rust resistant and corrosive resistant.

c. Three rotary valves made of PVC

(1) Non-corrosive

(2) Used to control flow of hot water to the suit.

(a) Top Valve is 0-100% flow

1. Bypass

2. Controls flow to arms and legs.

(b) Middle Valve

1. Controls the flow to the front of the body.

(c) Lower Valve

1. Controls the flow to the rear of the body.

9. Harness

a. Used as a safety lifting sling and will lift a diver in full dress.

b. Crosses legs, chest and back which has lifting eye. Show

c. Made of Nylon sewn and cemented to suit for strength.

10. Hot Water Hose

a. 1/2" ID Rubber Hose

b. Hose is buoyant in water

c. Snaptite fitting on diver's end (quick disconnect). Show

C. Maintenance

1. Maintenance recommended 10 to 50 hours of operation.

a. Inspect and clean

(1) Suit

(2) Boots

(3) Gloves

(4) Hose

b. Varies due to:

(1) Work being done.

(2) Type of bottom.

(3) Water being pumped through the suit.

c. Inspect and clean Control Valve Manifold

(1) Check for smooth operation

(2) Lubricate with silicon grease as necessary.

d. Inspect and clean all zippers

(1) Check for corrosion.

(2) Lubricate with silicon grease or "Zipper EZ" as necessary.

e. Removal of Crude Oil - breaks down neoprene if not removed

(1) Use hot detergent solution or Boraxo

(2) Rinse thoroughly with fresh water.

f. Removal of Tar

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(1) Any unhibited Menthol Chloroform applied to a cloth.

(2) Scrub with detergent solution or Boraxo

(3) Rinse with fresh water

g. Solvents: Avoid Contact with Hot Water Suit Emphasize

(1) Methyl Ethyl Ketone (MEK)

(2) Lacquer Thinner

(3) Acetone

(4) Toluene - will affect neoprene with long exposure.

D. Repair of Hot Water Suit

1. Similar to normal wet suit repair

a. After cementing rips or tears, use a blind stitch.

(1) If not used, a 1 inch overlap patch should be used.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
III. Summary		Ask questions as necessary
A. Usage		
1. Mk I Mask		
2. Clayton Diving Heater System		
B. Suit Construction		
1. 1/4" double nylon suit		
2. Hood (modification)		
3. Tubing		
4. Zippers		
5. Neoprene Gloves		
6. Neoprene Boots		
7. Velcro strips		
8. Hot Water Control Valve Manifold		
9. Harness		
10. Hot Water Hose		
C. Maintenance		
1. Inspecting and Cleaning Procedures		
D. Repair		

GPO 901-274

Diver, Second Class A-433-0022
Medical Deep Sea Diving Technician A-433-0020
Ship Salvage Diving Officer A-4N-0011
Depp Sea (HeO2) Diving Officer A-4N-0010

Security Clearance: Unclassified

Lesson Topic: 8.3 Clayton Diving Heater System

12 Hours

INSTRUCTIONAL MATERIALS

U.S.Navy Diving Manual, Volume I
NAVSHIPS 0994-007-5010
Student Guides
Standard Classroom Equipment
Chart/Transparency of Clayton Diving Heater System
Clayton Diving Heater

TERMINAL OBJECTIVES

1. When the student completes this course, he will be able to, as a member of a team tending a diver in open water, using Mk I Mask and Hot Water Suit Systems, demonstrate/explain startup/shutdown procedures (as applicable) and operate the Clayton Diving Heater System (or other Navy approved locally available similar equipment).

ENABLING OBJECTIVES

1. Orally explain the function(s) of the major components and component parts in terms of

ENABLING OBJECTIVES (Cont'd)

what they do for the system.

2. Given a standard print of the Clayton Diving Heater System, describe, by labeling, the physical location of the major components and their component parts.

3. Describe by illustration, the sources of power for the major components.

4. Describe, orally, the protection provided and the ratings of each of the major components.

5. Orally explain how the component parts carry out their function(s).

6. Describe, in writing, the major materials used in the component parts and explain why.

7. Describe, by illustration, the flow path of sea water through the sea water supply system.

8. Describe, by illustration, the flow path of steam from the auxiliary steam inlet to the auxiliary outlet.

9. Describe, by illustration, the flow path of fresh water through the fresh water and steam systems.

ENABLING OBJECTIVES (Cont'd)

10. Describe, by illustration, the fuel flow through the fuel system to the burner.

11. Orally describe lighting off/securing procedures.

12. Describe, by illustration, the location at which the following is monitored: operating steam pressure, maximum temperature to the diver, and sea water inlet pressure and flow.

13. Orally describe the effect on this system due to a ship's auxiliary steam/condensate system, fire main system and electrical source.

14. Orally describe the effect on the Diver's Hot Water Suit due to the operation of the Clayton Diving Heater System.

CRITERION TEST

1. As a member of a team tending a diver in open water, using Mk I Mask and Hot Water Suit Systems, demonstrate/explain startup/shutdown procedures (as applicable) and operate the Clayton Diving Heater System (or other Navy approved locally available similar equipment).

HOMEWORK

Volume II, Student Guide, Assignment Sheets 8-3-1A through 8-3-6A

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction		
A. Establish Contact	Introduce self and topic	
B. Establish Readiness	Get students ready to learn	
C. Establish Effect	Bring out need and value of material being presented.	
D. Overview	State Learning Objectives	

II. Presentation

A. General Description

1. The Clayton Diving Heater System is a self-contained unit which includes a closed system heater, sea water pump and heat exchanger.
2. Temperature Control Valves automatically blend the delivery temperature of sea water for one (1) to four (4) divers.
3. If required, the unit is also equipped to use an alternate source of heat, such as "ship's steam" instead of the integral heater.
4. The unit may be separated if desired.

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5. The Clayton Diving Heater System will develop its full rated pressure within 5 minutes from a cold start at the rated capacity of 550,000 BTU/Hr. The diving heater will deliver 2 to 10 gallons per minute of heated sea water within an adjustable temperature range of 95° to 195° under all conditions of sea water delivery pressure (65 to 125 psi) flow rate.
6. Temperature and pressure gauges are located throughout the system at various inlets and outlets.
7. The complete system is mounted on a welded skid frame.
8. Standard equipment includes safety devices for protection against water failure, excessive pressure and electrical overload, however, an attendent must be present during operation of the unit.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
B. Systems		Take notes as necessary
1. Freshwater and Steam System		
2. Sea Water Supply System		
3. Fuel System		
4. Electrical System		
C. Freshwater and Steam System Components		
1. Freshwater Makeup Inlet	Show on Chart	
a. Fills the system with properly treated water.		
b. Allows the operator to add make-up water as necessary.	Explain Make-up Water	
c. Located below the heater feed water pump.		
2. Make-up Water Valve	Show on chart	
a. Allows operator to add make-up water to the system.		
b. Located on the fresh water make-up inlet.		
3. Heat Exchanger Drain Valve	Show on chart Valve T	

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
a. Allows operator to drain heat exchanger. b. Located below the heating unit.	Question: Why drain heat exchanger? 1. Cold 2. Clean 3. Stowage	Respond to question as directed.
4. Fresh Water Pump a. Diaphragm-type pump. b. Designed to deliver a fixed volume of water into the system during operation. c. Electrically powered. d. Located between the heat exchanger and heating unit.	Show on chart	
5. Pump Head Drain Cock a. Used to drain Freshwater Pump b. Located on inlet and outlet side of pump.	Show on chart Valve N (2) Question: Why drain pump? 1. Cold 2. Stowage	
6. Pump Bleed Valve a. Used to allow trapped air to escape from pump. b. Located on the Intake Check Valve Cap.	Show on chart Valve P (2) Question: Why is it necessary to bleed off trapped air? 1. Pump won't prime. 2. Damage pump. 3. Damage unit.	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
7. Water Sample Valve	Show on chart Valve AC	
a. Used to obtain water sample for test.		
b. Located behind Fresh Water Pump.		
8. Relief Valve	Show on chart	
a. Allows excess steam pressure to vent off into the atmosphere.		
b. Located on top and to the rear of the heat exchanger.	NOTE: This is a Safety Device.	
9. Coil Drain Valve	Show on chart Valve C	
a. Used to drain heating coil.		
b. Located behind Freshwater Pump.		
10. Coil Feed Valve	Show on chart Valve A	
a. Allows steam heated in the boiler to pass into the heat exchanger.		
b. Located on the side near the top of the Burner unit.		
11. Wet Tube Heating Coil	Show on chart	
a. Water that is to be heated passes through this coil.	Green coil inside Heat Exchanger	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
b. Located inside the Heat Exchanger unit.		
12. Auxiliary Steam Shutoff Valve a. Used to secure steam when unit is being used with "ship's steam". b. Located on top and to the rear of the Heat Exchanger.	Show on chart Valve Z	
13. Auxiliary Steam Reducer a. Used to regulate steam pressure. b. Located on top and to the rear of the Heat Exchanger.	Show on chart Valve Y Question: Why do we need a reducer? 1. Unit is designed to operate at a set pressure. 2. Prevent damage to unit.	
14. Heat Exchanger a. Where water is heated which will be pumped to the divers. b. Operation - steam from the boiler enters the heat exchanger and flows around heating coil, heating the water.	Show on chart	

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY STUDENT ACTIVITY
15. Heat Exchanger Relief Valve	Show on Chart
a. Allows excess pressure inside heat exchanger to vent off.	
b. Located on top of heat exchanger.	NOTE: This is a safety device.
16. Heat Exchange Vent	Show on chart
a. Used during Lighting Off to allow trapped air to escape.	
b. Located near the top and to the rear of the Heat Exchanger.	
17. Heat Exchanger Pressure Gauges	Show on chart Gauge P
a. Allows operator to monitor pressure inside of heat exchanger.	
b. Located on the Mixing Panel.	
18. Heat Exchanger Sight Glass	Show on Chart
a. Enables operator to see level of water inside heat exchanger.	Question: Why do we need a sight glass? 1. Proper operation. 2. Damage to unit
b. Located on side of Heat Exchanger.	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
19. Heat Exchanger Shut Off Valve	Show on chart Valve M	
a. Allows water to return to boiler.		
b. Located below the fresh water pump.		
QUESTIONS ON STEAM OR FRESH WATER SYSTEM	Ask questions as necessary.	
D. Sea Water Supply System Components		
1. Sea Water Pressure Reducer Valve	Show on Chart Valve K	
a. Regulates sea water pressure	Question: Why do we need a reducer or regulator? 1. Firemains usually have too much pressure. 2. Possible damage to the unit.	
2. Inlet Temperature Gauge	Show on chart Gauge T	
a. Allows operator to see temperature of sea water.		
b. Located on Sea Water Supply Pump.		
3. Inlet Pressure Gauge	Show on chart Gauge P	
a. Allows operator to monitor supply pressure.	Question: Why is it important to have an inlet pressure gauge? 1. Proper operation of the unit. 2. Prevent damage	
b. Located on Mixing Panel.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
4. Supply Pump	Show on chart	
a. Used to supply sea water into the sea water system.		
5. Heat Exchanger Coil	Show on chart	
a. Sea Water passes through this to be heated.		
b. Located inside the Heat Exchanger.		
6. Heat Exchanger Temperature Gauge	Show on chart Gauge T (above F Valve)	
a. Allows operator to monitor temperature of the Heat Exchanger.	Question: Why would we want to know the temperature? 1. Prevent damage 2. Could be the first sign of trouble. 3. Economy	
b. Located at the top and to the rear of the Mixing Panel.		
7. Temperature Regulator Valves	Show on chart Valve J (5)	
a. Used to raise or lower the water temperature to the diver(s).		
b. Located on the Mixing Panel.		
c. Works by allowing cold water to be added or reduced to the heated water being pumped		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
to the diver(s).		
8. Regulator Temperature Gauges a. Enables operator to monitor the water temperature being pumped to the divers. b. Located on the Mixing Panel.	Show on chart Gauge T (Above J Valves)	
9. Sea Water Outlet Safety Shut Off Valve a. The Safety Shut Off Valve will automatically close when the heated sea water temperature is not within set limits. b. Located behind Mixing Panel. c. Works through the principle of Liquid Volume Change. With a variation in temperature, the liquid in the Sensing Tube, located in the Outlet Safety Shut Off Valve, expands or contracts causing the bellows to actuate the switching mechanism.	Show on Chart Valve W NOTE: This is a Safety Device. Explain.	
10. Outlet Valve Pressure Gauge #16	Show on chart Gauge P on J Valve Manifold	

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OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

a. Allows operator to monitor hot water pressure to diver(s).

b. Located on Mixing Panel.

11. Outlet Valve Manifold — Show on chart

a. Connection for Hot Water Hose

b. Located on the Mixing Panel (near the bottom).

QUESTIONS ON SEA WATER SUPPLY SYSTEM — Ask questions as necessary.

E. Fuel System

1. Fuel Tank — Show on chart

a. Holds fuel for boiler.

b. Usually portable.

c. Should be of sufficient size.

2. Fuel Filter

a. Element-type cartridge

b. Located between fuel tank and fuel pump.

3. Fuel Pump — Show on chart

a. Supplies fuel to the burner

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
4. Burner Control Valve	Show on chart Valve R	
a. Used to increase or decrease the fuel supply to the Burner.		
b. Located between the Fuel Pump and the Burner.		
c. Also used as a Fuel Bypass.		
d. Can be used as an emergency Shut off for Burner.		
5. Fuel Pressure Switch	Show on chart	
a. When fuel pressure rises, the fuel pressure switch closes and energizes the Combustion Control Switch.		
b. Located in the Fuel Line between the Fuel Pump and the Burner.		
6. Fuel Pressure Gauge	Show on chart	
a. Allows operator to monitor fuel pressure.		
7. Burner Manifold	Show on chart	
a. Location for mixing of fuel and air.		
b. Located at bottom of Burner.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
8. Blower	Show on chart	
a. Supplies air under pressure to Burner.		
b. 1/2 HP, 115/230 V, 1725 RPM		
QUESTIONS ON FUEL SYSTEM		Ask questions as necessary.
F. Electrical System Components		
1. Heater Starting Switch	Show on chart Switch D	
a. Located on Main Power Panel next to Heater.		
b. When switch is on, it engergizes:		
(1) Heater Motor		
(2) Feedwater Pump		
(3) Blower		
(4) Ignition Transformer		
(5) All Safety Switches in the system		
2. Thermostat Switch	Show on chart Switch V	
a. Located on side of Heater.		
b. This is a Safety Switch.		
c. When coils inside Burner expand the switch shuts off the Burner to prevent		

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damage to the unit.

3. Steam Pressure Switch — Show on chart
   a. Located within the Burner.
   b. Contacts on switch turns Burner controls on/off.
   c. Switch goes on when a drop of 10 psi occurs in steam pressure.
   d. Switch shuts off when steam pressure excedes operating limits.
4. Heater Motor — Show on chart
   a. Located to the rear and to the right of the Heater.
   b. Motor has 1/2 HP, 115/230 V, 60 HZ at 1725 RPM.
   c. Supports 3 other Components:
      (1) Fuel Pump
      (2) Feedwater Pump
      (3) Blower
5. Sea Water Booster Motor — Show on chart

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a. Located below Mixing Panel.

b. Drives a centrifugal pump in order to boost sea water pressure.

c. 1 HP, 115/230 V, 60 HZ

d. Pumps 2 1/2 to 10 GPM @ 70 psig — Show on chart

e. Switch for Pump located above Mixing Panel.

6. High and Low Temperature Limit Controller and Temperature Gauge — Show on chart

a. Located on Mixing Panel.

b. Allows operator to select a high and low temperature.

c. This is a Safety Device.

d. If temperature rises or falls past settings the Audible Alarm sounds.

7. Audible Alarm — Show on chart

a. Located within the Electric Panel . Box above Mixing Panel.

1770 b. This is a Safety Device. 1771

c. Indicates something is wrong.

d. Controls Actuator Valve

(1) When alarm goes off, Actuator secures water going to diver.

8. Audible Alarm Switch On/Off and Reset Switch — Show on chart Switch AA Switch AB

a. Located on same panel as Alarm, above Mixing Panel.

b. These two switches reopen the Actuator Valve when temperature is back to normal.

c. Must be manually operated.

III. Summary

A. Fresh Water and Steam System

1. Fresh Water Inlet Makeup

2. Make-up Water Valve

3. Heat Exchanger Drain Valve

4. Fresh Water Pump

5. Pump Head Drain Cock

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6. Pump Bleed Valve
7. Water Sample Valve
8. Relief Valve
9. Coil Drain Valve
10. Coil Feed Valve
11. Wet Tube Heating Coil
12. Auxiliary Steam Shut Off Valve
13. Auxiliary Steam Reducer
14. Heat Exchanger
15. Heat Exchanger Relief Valve
16. Heat Exhanger Vent
17. Heat Exchanger Gauges
18. Heat Exchanger Sight Glass
19. Heat Exchanger Shut Off Valve

B. Sea Water Supply System

1. Sea Water Pressure Reducing Valve
2. Inlet Temperature Gauge
3. Inlet Pressure Gauge
4. Supply Pump

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5. Heat Exchanger Coil
6. Heat Exchanger Temperature Gauge
7. Temperature Regulating Valves
8. Regulator Temperature Gauge
9. Sea Water Outlet Safety Shut Off Valve
10. Outlet Valve Pressure Gauge
11. Outlet Valve Manifold

C. Fuel System

1. Fuel Tank
2. Fuel Filter
3. Fuel Pump
4. Burner Control Valve
5. Fuel Pressure Switch
6. Fuel Pressure Gauge
7. Burner Manifold
8. Blower

D. Electrical System

1. Heater Starting Switch
2. Thermostat Switch
3. Steam Pressure Switch

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
4. Heater Motor		
5. Sea Water Booster Pump		
6. High and Low Temperature Limit Controller and Gauge		
7. Audible Alarm		
8. Audible Alarm Switch and Reset		
IV. Practical Work		
A. Start-up Procedures	Use Checklist (attached) to demonstrate	
B. Operating Procedures	Use Checklist (attached) to demonstrate	
C. Shut-down Procedures	Use Checklist (attached) to demonstrate	
D. Student Operation: During completion of the Searching Project using Mk I Mask and Hot Water Suit, have students perform start-up, operating, and shut-down procedures. After initial start-up, have second student describe start-up procedures as well as shut-down procedures. Last student of day's diving will shut down boiler.		Use Checklist (Job Sheet) in Student Guide for Start-up, Operating, and Shut-down procedures.

CLAYTON DIVING HEATER STARTING,OPERATING AND SHUT DOWN PROCEDURES

1. Start Heater with Switch (D) on Electrical Controls Panel.

CAUTION

Be sure fuel lines are open and fuel is circulating through system. If operated without fuel, the Fuel Pump will quickly score and be damaged beyond repair. On initial start, disconnect return line to fuel supply container to check flow and thus be certain that fuel is circulating.

2. Remove pipe plug from Chemical Fill Elbow marked "Add Chemical".

3. Open fresh, soft or treated Make-up Water Valve (s).

4. Prime Water Pump Valve Housings by opening Pump Bleed Valve (P) on Intake Check-valve caps until air is expelled. If Pump fails to prime, loosen Intake Valve Caps two turns (Check Valve Wrench furnished) to eliminate air; then tighten. When Plant is started initially, after storage, or if it has been idle for a long time, remove Intake and Discharge Valve Caps from Feedwater Pump Housings and wipe the Discs and Seats with a clean cloth to insure proper seating. Be sure Check-valves are installed into the same port from which they were removed.

5. If Pump fails to prime upon initial start, or if Plant is started when completely dry, close Make-up Water Valve (S) and remove Intake Valves from Feedwater Pump; then open Make-up Water Valve (s) just long enough to allow Water Pump Columns to fill completely. When Pump Columns are full, replace Check-valve caps and reopen Water Valve (S). (22)

6. Check Water Pump for prime by throttling Coil Feed Valve (A). If pump is primed, pressure will rise on Heater Feed Pressure Gauge when Valve is nearly closed. Reopen Coil Feed Valve (A) after check.

7. Allow system to fill with soft, fresh, make-up water until level is maintained approximately 1/2" in Gauge Glass (5). This is the cold water level, when heated the water level will be maintained between 1/2 and 3/4 full in Gauge Glass (5). Close inspector's Gauge Valve (13) after correct level in Heat Exchanger has been reached and system is balanced.

NOTE

Approximately 9 gallons of water is required to fill the system when cold.

8. Add 4 ozs of Clayton Manufacturing Company water treatment chemical 1-A dissolved in 1 quart of warm water to the Heat Exchanger through Pipe Elbow (3) marked "Add Chemical". Replace pipe plug (3).

NOTE

If pressurized fresh water make-up line is not available the necessary amount of water may be introduced into the system through Pipe Elbow (3).

CLAYTON DIVING HEATER PROCEDURES (CONT'D)

9. Once per week, add 4 ozs of Clayton Manufacturing Company water treatment chemical A-1 to the system.

IMPORTANT

Following correct Chemical treatment instructions will insure oxygen, dissolved solids, and alkalinity control. For treatment details see Feedwater Treatment Sheet (R-5235) in Clayton Diving Heater Technical Manual.

10. Open at least one Sea Water Supply Valve (J) and start Sea Water Booster Pump (4) with Switch (E).

NOTE

Never operate Pump without adequate supply of sea water (minimum 12 gpm). Adjust Sea Water Pressure Reducing Valve (K) for 40 psi delivery.

11. After starting Pump, press Reset Switch (AB) to silence alarm, and open Safety Shut-off Valve.

STARTING BURNER

NOTE

On initial start, actuate Reset (B) on Combustion Control before starting Burner. This will insure that the Control is set for a normal Burner start.

12. Be sure the correct cold water level is being maintained in the Gauge Glass (5), then fully close Burner Control Valve (R). Burner will ignite when fuel pressure rises above 10 psi.

13. Allow Plant to operate for 3 minutes then check water level in Heat Exchanger Water Level Gauge (5). Drain excess water (above 3/4 full) by opening Heat Exchanger Drain Valve (T). If more water is needed to maintain normal, correct level in Heat Exchanger (1/2 to 3/4 full), open Make-up Water Supply Valve (S) and close Shut-off Valve (M) between Heat Exchanger and Water Pump. IMPORTANT: After water level is obtained open Valve (M) and close Make-up Water Supply Valve (S).

14. Open Inspection Valve (13) for 10 seconds to bleed air from system at each start up.

AUTOMATIC OPERATION

15. The Steam Pressure Switch (SPS) will open and shut off the Burner when steam pressure rises to the adjusted maximum cut-out pressure (50 psi). When steam pressure drops to about 10 psi below the maximum, the Steam Pressure Switch will automatically cut in and restart the Burner.

16. Burner failure will actuate the Combustion Control to safety shut off about 45 seconds after failure. To restart Burner, wait 2 or 3 minutes for the thermal element to cool; acutate the Reset (B) on the Combustion Control.

(23)

CLAYTON DIVING HEATER OPERATING PROCEDURES (CONT'D)

17. Low water or water failure will actuate the Thermostat Control to stop the Burner. If the Burner shuts down due to thermostatic action find and correct the cause of insufficient water before resuming operation.

18. The Reset Button on the front of the Thermostat Switch (V) must be pressed to restart the Burner.

CAUTION

Be sure an adequate amount of water is in the system and thus eliminate any possibility of damage.

PERIODIC, OVERNIGHT, OR WEEKEND SHUTDOWN

19. Shut-off Burner by opening Burner Control Valve (R).

20. Set lower temperature limit, on Temperature Limit Controller (G), to lowest setting.

21. Allow heater to operate for five minutes then turn off Switch (D and E).

22. Flush sea water systems with fresh water by using fresh water at the sea water inlet and operating Seawater Pump.

NOTE

It may be necessary to hold in on Safety Shut-off Valve Reset Switch (AB) if fresh water temperature is too low.

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* Numbers and letters in parentheses refer to Figure 4-1, Clayton Diving Heater Instruction Manual NAVSHIPS 0994-007-5010

SPO 901-275

NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022
Medical Deep Sea Diving Technician A-433-0020
Ship Salvage Diving Officer A-4N-0011
Deep Sea (HeO2) Diving Officer A-4N-0010

Security Clearance: Unclassified

Lesson Topic: 9.1 Underwater Tool

30 Hours

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual, Vol. I
Student Guides
Standard Classroom Equipment
Mk I Mask and Related System
Underwater Tools:
- Drill
- Tap
- Wrenches
- Velocity Power Driver
- Studs
- Hydraulic Piling Saw
- 12" X 12" Wood for sawing

Overhead Projector
Transparencies
16mm Projector
Film MN9915D

TERMINAL OBJECTIVE

1. When the student completes this course, he will be able to, in an open tank, with at least eight feet of water, using the Mk I Mask and appropriate underwater tools, complete the following projects in accordance with Diving Training Standards: Three Hole Flange, Drill and Tap, and Underwater Piling Saw (Hydraulic).

ENABLING OBJECTIVES

1. Orally DEFINE/EXPLAIN terms relative to the use of underwater tools.
2. Orally DESCRIBE a surface supplied hydraulic set-up and the basic operation of selected underwater tools.
3. Orally DESCRIBE how the underwater tools work with selected attachments.
4. Orally DESCRIBE the special insulating and safety requirements for underwater electric tools and lights.
5. Orally DESCRIBE loading and firing procedures and techniques for using the velocity power driver.
6. For the velocity power driver, pneumo-hydraulic grinder and drill:
   a. Orally EXPLAIN the function(s) of each tool in terms of what they do for the system.
   b. DESCRIBE, in writing, the sources(s) of power.

ENABLING OBJECTIVES (cont'd)

c. Orally DESCRIBE the modes of control.
d. Orally LIST the protective devices and ratings for each tool.

7. Given a job analysis sheet on each project to be completed during this unit, orally EXPLAIN the following aspects of the project:
a. What the project is.
b. Conditions under which the project is to be completed.
c. Standards which will determine success.
d. How to perform the project successfully.
e. How each relates to a fleet diving job.
f. Particular skills necessary for the successful completion of the project.

CRITERION TEST

In an open tank, with at least eight feet of water, using the Mk I Mask and appropriate underwater tools, complete the following projects in accordance with Diving Training Standards: Three Hole Flange, Drill and Tap, and Underwater Piling Saw (Hydraulic).

HOMEWORK

Student Guide, Vol. I Information Sheets 9-1-1I through 9-1-37I, Assignment Sheets 9-1-1A through 9-1-3A, Job Sheets 9-1-1J through 9-1-6J.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction		
A. Establish Contact	Introduce self and topic.	
B. Establish Readiness	Get Students Ready to Learn 1. Pencil and paper 2. Room condition 3. Periods 4. C.R. Procedures	
C. Establish Effect	Bring out need and value of material.	
D. Overview	State Learning Objectives	
II. Presentation		
A. Terms and Definitions	List terms on C/B or use transparency	Observe and take notes as necessary.
1. Hydraulic: operated by employing water or other liquid.		
2. Pneumatic: Operated by air.		
3. Explosive Tool: an inert device used in conjunction with an explosive to perform work.		
4. Torque: that which tends to produce rotation.		
5. Pump: an apparatus used for transferring		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
a liquid; or, verb, to transfer a liquid.		
6. Compressor: a machine by which gas (air) is compressed so that its expansion may be utilized by a source of power.		
7. By-Pass: alternate route or detour.	Give example related to diving.	
B. Underwater Tools	Show actual tools or use transparency/chart/picture as appropriate	Observe and take notes as necessary.
1. Hand Tools		
a. Screw Driver		
(1) Phillip's best.		
(a) better grip		
(b) better torque		
(c) sometimes used with adjustable wrench for tightening or loosening.		
b. Hammers		
(1) Various sizes required - larger than used on surface for same job.		
(2) Various types		
(a) Ball peen, Sledge, Machinist		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
c. Rachet wrench and sockets		
(1) Used for removing bolts on grating		
(2) Quicker than using adjustable wrench		
d. Crescent (adjustable) wrench		
(1) Adjustable to various sizes		
(2) Tendency to round bolt heads		
(3) Sometimes used with screwdriver		
e. Hacksaw		
(1) Often works better with teeth pointed toward diver.	Explain.	
(2) Useful to have teeth ground on one side to cut nylon line.		
f. Portable hoists and chain falls		
(1) Used for moving objects into place	Give example (changing ship's screw)	
(2) Lowers heavy objects from the surface		
g. Allen Wrenches		
h. Files		
2. Pneumatic Tools		
a. Best suited for shallow water work (-50')		

b. Air pressure driven

c. Advantages

(1) Smaller than equivalent electric tool

(2) Cheaper than equivalent hydraulic tool

(3) Available through Government supply system

(4) Not harmed by rapid reversals or stalling

d. Disadvantages

(1) Noisy

(2) Air Bubbles hamper visibility

(3) Excessive maintenance

(4) Required pressure and compressor (scfm) increase with depth.

e. Tools using rotating air motors

(1) Drills - not recommended for diving operations

Drill bits grab metal and spin diver.

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(2) Impact Wrenches

(3) Chain and Circular Saws

(a) dangerous in limited visibility

(4) Grinder

(5) Hull Scrubber

f. Tools using reciprocating pistons

(1) Chipping hammers

(2) Reciprocating Saw

(a) useful for cutting wood or metal

(3) Pavement breakers and jackhammers

g. Use and Maintainenance

(1) Tools with unpressurized air spaces

(a) may fail to operate if spaces flood

(b) flooding can sometimes be avoided through continuous operation (tape trigger down).

(2) Tools with control valve on the exhaust side of the motor.

(a) preferred over those with control valve on inlet side

(b) does not flood when pressurized but not operating

(c) few tools made this way

(3) In-line oiler

(a) should be used at all times

(b) recommend water-displacing oil

(4) Storing Overnight

(a) operatre in a bucket of light oil or diesel oil and leave it in the oil

(b) Swedish Navy - tools are left in the oil - running slowly.

(5) Before placing in storage after use underwater:

(a) disassemble

(b) clean

(c) oil

(d) reassemble

(e) test

h. Air Required — List on C/B — Observe and take notes as necessary

(1) Most require inlet pressure of 90 psig and 5-30 scfm on surface.

(2) Pressure at compressor (10% variation allowable)

(3) Undersized compressor will not maintain 90 psig and allow tool to work efficiently.

(a) volume tank — Explain.

(4) Fluid friction increases with scfm and distance. Also increases as hose size decreases.

SHOW FILM ON AIR AND HYDRAULIC TOOLS

3. Hydraulic Tools

a. Characteristics — List on C/B or use transparency

(1) Tool resistence creates pressure.

(2) Tool torque results from pressure supplied (psi).

(a) torque = rotational force (measured in foot pounds).

(3) Tool speed results from flow rate (gpm)

(4) Friction losses become heat.

(5) Hydraulic power of tool:

$$HP = \frac{gpm \times psig}{1714}$$

(6) Friction losses.

(a) Hose size and psi available at the tool are not affected by having components submerged.

(7) Hydraulic fluids

(a) Thick (high viscosity) fluids are desirable for good lubrication and efficient tool/pump operation.

(b) Thin (low viscosity) fluids minimize friction losses in components.

(c) M.L-H-5606B (Cherry Juice)

1. Aircraft hydraulic fluid
2. Medium Viscosity
3. Tools 40-60% efficient
4. Flammable

(d) Tool develops hydraulic pressure

1. Low pressure at tool and high pressure at pump - hose size must be increased.

(8) Components needed for power source. Refer to drawing/picture/transparency

(a) Reservoir - stores fluid.

(b) Temperature gauge - records temperature of fluid.

(c) Filter - protects pump and tools

(d) Pump - positive displacement, vane type.

(e) Diesel Engine - air cooled, electric start

(f) Relief Valves - two - one

set at 2000 psig, one variable 500-2000 psig.

(g) Flow controller - controls flow to the circuit 2-12 gpm.

(h) Pressure gauge - pressure in tool circuit (before hose).

(i) Flow meter - flow in hose to tool

(9) Advantages List on C/B

(a) smaller than equivalent electric or pneumatic tools.

(b) not harmed by stalling

(c) less affected by depth

(d) no bubbles - little noise

(e) low maintenance required

(10) Disadvantages

(a) not in government supply system

(b) expensive ($500-1,000 each)

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(11) Open-Center hydraulic tools commercially available (usually require special seals).	Show tools or picture of tools as appropriate	
(a) Impact wrench		
1. Most useful		
2. For bolts up to 3" diameter studs.		
3. Also preferred for drilling		
(b) Chain Saw		
1. Effective but dangerous	Emphasize.	
2. Piling cut - safer if used with clamp-on bracket.		
(c) Grinder- one of the most useful		
1. Abrasive saw attachments are too underpowered for use underwater.		
(d) Drill - not recommended as a hand tool because of spin when bit binds.		

(e) Sump Pump - when used with pressure-balanced nozzle and 10' fire hose, great jetting tool; produces 200 gpm.

(f) Tamper - has not been evaluated underwater. May be useful as large chipping and rod driver.

(g) Hull Scrubbers

(h) Cutters (wire rope and pipe).

C. Units of Hydraulic Power Tools in Package - drawn for salvage use from ESSM Pool

1. Ackley MOD6 HS-OC Impact Wrench — Show actual tool, drawing or transparency

a. Designed for use underwater with impact sockets up to one inch.

b. Can be used for drilling and tapping holes up to 5/8" diameter.

c. Specifications:

(1) Chuck 5/8" quick-change hex drive Jacobs type 3B.

(2) Maximum Chuck speed 850 rpm.

(3) Flow rate to tool 4-6 gpm.

(4) Operating Pressure 1000-2000 psig

(5) Weight 10 1/2 lbs

(6) Torque 250 ft lbs

d. Nut Running

(1) Use 5/8" hex to 1/2" square adapter in order to incorporate standard impact sockets.

(2) Can be used in forward or reverse for tightening or loosening bolts.

(a) CAUTION: Wrench will twist heads and strip threads in mild steel bolts if excessive impacting occurs.

e. Drilling and Tapping

(1) Use same procedure as topside

(a) Drill pilot hole first

(b) Follow with tap drill.

1. use carbon or high speed steel drill bits.
2. do not allow drill to impact as it will cause drill bit cutting edge to flake off.
3. start drill to speed before contacting metal surface to be drilled.
   a. minimizes drill motor impacting.

(c) Taps should be run in slowly without reversing direction.

1. discard taps after 4-6 uses as they are likely to break.
2. coat with water resistent grease prior to usage to reduce breakage.

f. Maintenance

(1) Daily

(a) Wash off with fresh water

(b) Spray with WD-40

(2) Pre-storage

(a) Remove hammer case and replace water-resistent grease on impact mechanism (never disassemble the impact hammer assembly).

(b) Grease the Jacobs Chuck with water resistent grease (Stalube GS-41).

(c) Reassemble and test

q. Prolonged use underwater

(1) Never allow drill to be left in contact with any dissimilar metal as excessive and rapid corrosion of the aluminum casing will occur.

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

2. Ackley MOD 13 HS-OC Impact Wrench — Show actual tool, drawing or transparency

a. Designed for use underwater with impact sockets from 1 - 1 1/2"

b. Used for running nuts and bolts only.

c. Specifications

(1) Maximum speed 850 rpm

(2) Flow rate to tool 4-4 1/2 gpm

(3) Operating pressure - 1000-2000 psig.

(4) Impact frequency - 1700 blows per minute.

(5) Weight 13 3/4 lbs

(6) Torque - 375 ft lbs

d. Nut Running

(1) Uses 3/4" square drive impact sockets.

(a) held in place by strand of #12 gauge copper wire inserted through socket and square drive of tool.

1. Twist ends together and bend over to minimize change of wire tearing

diver's hands or equipment.

(b) Very difficult to change under-water.

e. Maintenance

(1) Same as with Ackley MOD 6 HS-OC Impact Wrench.

3. Ackley MOD 24 HS-OC Grinder — Show actual tool, drawing or transparency

a. Designed for use underwater with grinding wheel and wire brush.

b. Specifications

(1) Power Rating 4-6 hp

(2) Flow Rate to tool 6-10 gpm

(3) Motor Speed 455 rpm

(4) Weight 14 lbs

(5) Maximum grinding wheel diameter - 7"

(6) Shaft size 5/8" x 11" unc thread.

c. Operating Procedures

(1) When using larger grinding wheels it may be difficult to handle tool.

(a) Decrease flow rate at pump

(b) Ideal flow rate produces drag force of 800-1000 psig when grinder is rotating.

(c) Decreasing flow rate also decreases available shaft horse power at tool.

d. Grinding Wheels

(1) Specifically formulated for underwater use.

(a) Abrasive grains larger and softer than on wheels used topside.

(b) Wheel sharpens self by fracturing individual grains to expose new sharp edges and by spalling off whole dull grains.

(c) Surface wheels can be used but make work go slower.

e. Maintenance

(1) Daily and Prestorage - wash with fresh water and spray with WD-40.

f. Repair

(1) Reliable and seldom needs repair

(2) If unit fails to operate:

(a) Check to see that hose couplings are mated together and that hydraulic oil is flowing to tool.

(b) If tool still does not operate, must be disassembled.

1. Refer to MFG Operating Manual.

4. Ackley MOD 7 HS-OC Chain Saw — Show actual tool, drawing or transparency

a. Not supplied with Hydraulic Tool Package.

b. Designed for use underwater for cutting bulwarks, pilings or large wooden structures.

c. Specifications

(1) Cutting capacity: 0-21 inches

(2) Flow rate to tool 8 gpm

(3) Chain Speed 3000-3500 fpm

(4) Operating pressure 1000-2000 psig

(5) Weight 7 lbs

(6) Automatic Bar and Chain Oiler built in.

d. Operating Procedures

(1) As if you were operating topside.

e. Maintenance

(1) Daily and Prestorage: wash off with fresh water and spray with WD-40.

(2) Roller nose on chain saw bars should be greased with water resistent grease after every operation.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY STUDENT ACTIVITY
5. Onan Powered Hydraulic Pumping Unit	Show actual equipment, Observe and refer to chart or transparency. Student Guide. If actual equipment available, instructor should demonstrate and explain preparation, starting, operating and shutdown procedures.
a. 4 cylinder diesel driving variable pressure, variable flow pump.	
(1) Mounted on fork truck skid assembly.	
b. Preparation	
(1) Check level of hydraulic oil, diesel fuel and diesel lube oil (dipstick inside oil fill cover).	
(2) Connect hydraulic lines to tool and power source.	
(3) Close flow control valve by turning clockwise until it stops. Be sure locking knob has not engaged before flow control valve is completely closed.	
c. Starting	
(1) Above 55° F (air temperature)	
(a) Push the PREHEAT button and hold for 20 seconds.	

(b) Continue holding PREHEAT button, push the FUEL SOLENOID switch to "ON" and press the START switch.

(c) Release the START switch and PREHEAT button after the engine starts and reaches speed. Lube oil pressure should read at least 20 psi.

(d) When the engine is to be restarted after short periods of shutdown, preheating is usually not necessary.

NOTE: The PREHEAT switch is part of the starting circuit and must be depressed along with the start switch to provide power to the engine starter motor.

(2) Below 55°F (air temperature)

(a) Refer to NAVSHIPS Tech Manual 0994-013-1010, paragraph 2.3.1.6

d. Stopping

(1) Turn FLOW CONTROL knob and PRESSURE CONTROL knob clockwise until closed.

(2) Turn off FUEL SOLENOID switch.

(3) Disconnect tool and hydraulic hose.

(4) Replace dust caps on all quick connect fittings.

(5) Wash all equipment which has been exposed to salt water or spray with fresh water.

Note: Do not wash down diesel unit until it is completely cool.

e. Operation

(1) Setting Maximum Operating Pressure. Most hydraulic tools are designed for a maximum pressure of 2000 psig. For these tools, the PRESSURE CONTROL KNOB should be turned clockwise until it stops. For hydraulic tools with maximum pressure below 2000 psig, use the following procedures:

(a) Start the diesel engine.

(b) Disconnect the hydraulic line at the power source.

(c) Open the FLOW CONTROL knob (counter-

clockwise) one-half turn.

(d) Turn the PRESSURE CONTROL knob (counter clockwise to decrease pressure, clockwise to increase pressure until the pressure gauge shows the maximum recommended working pressure for the tool.

(e) With the FLOW CONTROL knob still open, turn off the diesel engine by pushing the FUEL SOLENOID switch to its OFF position. When the pressure gauge indicates 0 psi, turn the FLOW CONTROL knob clockwise until it stops. Reconnect the high-pressure hose and start the diesel engine.

(2) Setting Flow Rate. The pump begins to pump hydraulic fluid as soon as the engine is started. The rate-of-flow

may further be varied with the FLOW (GPM) CONTROL knob. Therefore, initial and gross flow rates should be established by increasing the engine rpm with the throttle. To get the correct flow rate for a tool:

(a) Connect the tool to the power unit.

(b) Start the engine.

(c) Open the FLOW CONTROL knob (counter-clockwise) until the correct flow rate (from tool manufacturer's handbook) is indicated on the flow gauge on the front control panel.

(3) Changing Tools. Before a new tool can be hooked to the power unit, the pressure in the hydraulic lines must be allowed to drop to 0 psi. This is most easily accomplished by the following procedures:

(a) With the diesel running, close the FLOW CONTROL knob completely (turn clockwise).

(b) When the pressure has dropped to 0 psi, disconnect the tool from the hydraulic lines and replace with new tool.

NOTE: If a tool becomes accidently disconnected during operation, immediately shut off diesel engine. Leave FLOW CONTROL knob open until pressure drops to 0 psi. Close FLOW CONTROL knob (turn clockwise) and reconnect tool.

(c) Reset flow rate as outlined above.

D. Diver-Powered (Hand Pump) Hydraulic Tools/ Porta Power

Show actual equipment, chart or transparency.

Observe and take notes as necessary.

1. Are suitable for small jobs or emergencies.
2. Small, relatively cheap system with a heavy work capability.
3. Cutters and jacks small enough to be handled by divers require small volumes (less than a pint) of high pressure (2000-8000 psig) hydraulic fluid.
4. Component Function

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a. Pump

(1) Sealed and compensated reservoir stores fluid.

(2) Piston pressurizes fluid.

(3) Check valve prevents return flow of fluid.

(4) Check valve protects against over-pressure.

(5) Bypass valve allows fluid to return to reservoir.

b. Hose - conducts hydraulic fluid to tool.

c. Couplings - connect hose to pump and tool.

d. Tool - does the work; spring or load returns fluid to pump.

5. Best power source is a two-stage manual pump.

a. Modified to pump on the up stroke.

b. Pumps used below 30 feet should have pressure compensated reservoir.

c. Pump can either be at the job site or

on the surface.

6. Cutters Available

   a. Wire rope (1 - 1/8 inch diameter and 2 1/2 inch diameter)

   b. Steel bar to 5/8 inch diameter.

   c. 3 inch diameter copper and aluminum wire.

7. Cylinders are available for both pushing and pulling.

8. These pumps and tools require some maintenance.

   a. Change oil (MIL-H-6083C) regularly.

   b. Store jacks and cutters with cylinders extended to fill inside with oil; must protect rams from damage.

9. A device to convert medium pressure (2000 psig) hydraulic fluid to 10,000 psig is now being developed commercially. This will permit the use of high pressure

Show actual equipment, chart or transparency

cutters with a surface supplied power source.

E. HK Porter MOD HRC 118 Cable Cutter — Show actual equipment, chart or transparency.

1. Treated with black oxide and molybbdenum disulfide coating to reduce corrosion.
   a. Renumbered by MFG to MOD36262 because of special coating.
2. Will not work with powered hydraulic unit.
   a. Does not produce enough pressure to operate.
   b. Does not allow cutter to retract due to back pressure in return hose.
   c. Must be used with diver actuated hand pump.
   d. Operate as required - will accommodate up to 1 1/8 inch diameter wire rope.
   e. After pump and cutter are returned to the surface:
      (1) Extend cutter blade.

(2) Let cutter blade retract 1/4 to 1/2 inch.

(3) Disconnect pump.

(4) Install plugged male coupling in female coupling on cutter.

(5) WARNING: If this procedure is not followed, the useful life of the cutter will be drastically reduced.

3. Maintenance

a. After each use, wash with fresh water and spray with WD-40.

b. If cutter is disassembled:

(1) Repack spring cavity 30% full with Neverseez (FSN 8030-251-3980)

(2) Refill cutter with MIL-H-6083C Hydraulic Fluid.

c. Cutter blade is designed to have 1/64 inch flaton cutting edge. Do not sharpen to knife edge.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
F. HK Porter MOD 1770 MCK Bar Cutter	Show actual equipment, chart or transparency	
1. Capacity		
a. 11/16 inch for soft metals and mild steel.		
b. 1/2 inch diameter for hardened steel.		
2. Operational Proceudres - same as that for cable cutter.		
G. Enerpac RC 106 and RC 1010 10 Ton, Jacks and BU 300A 5 Ton Self Contained Jacks	Show actual equipment, chart or transparency	
1. RC 106		
a. Rated capacity - 10 tons		
b. Hydraulic Pressure applied 8960 psi.		
c. Plunger stroke 6 1/4 inches.		
2. RC 1010		
a. Rated capacity - 10 tons		
b. Hydraulic pressure applied 8960 psi.		
c. Plunger stroke 10 1/4 inches.		
3. BU 300A		
a. Rated capacity - 5 tons		

b. Plunger stroke 5 1/2 inches.

c. Diver operated.

d. No connections; self contained.

4. All rams use MIL-H-6083C oil.

5. A variety of attachments can be used with rams.

a. All attachments rated at 5 tons.

b. Made of special alloy steel.

6. Maintenance

a. Wash off with fresh water.

b. Spray any exposed threads with Neverseez

c. Spray units with WD-40

H. Diver Operated Hydraulic Pump Enerpac MOD P-80-2 — Show actual equipment, chart or transparency

1. Modified commercial pump.

a. Pumps on upstroke instead of down stroke.

2. Can be operated underwater by diver or

on deck by topside personnel.

a. Supplied with 10 ft. lead hose for underwater use.

b. Has depth pressure compensator built in.

c. When operated topside, use 100 ft. lead hose.

(1) Takes twice as many strokes due to expansion of braids of 100 ft. lead hose.

3. Installed on aluminum base with knee rests and toe holds.

I. Hydraulic Pulling Cylinder Bruning MOD 4000 Show Actual Equipment, chart, or transparency

1. Rated at 5 tons

2. Supplied with 10 ft.of special alloy steel chain.

a. By moving chain hook after each retraction, it is possible to move load 6 inches per cylinder stroke.

3. Depth limit 150 ft due to air pressure in accumulator.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
a. Accumulator is used to extend rod cylinder after retraction.		
b. Maintain charge at 70-90 psig.		
c. Automotive type tire valve.		
4. Maintenance		
a. Wash off with fresh water after use.		
b. Make sure cylinder rod is retracted.		
c. Spray with WD-40.		
J. Electric Tools	Show actual tools, chart or transparency.	
1. A limited number of electric tools are available for underwater use.		
a. Battelle Laboratories made several 5/8 hp tools with adapters for drilling, impacting, grinding and hole sawing. Some of these are under evaluation by NAVSHIPS Code 00C (SUPSALV).		
b. Underwater electric lights are often used for inspection and photography.		

c. Submersible Pumps are often in the water simultaneously with divers.

d. Underwater electric cutting torches and welding equipment.

e. Submersible electrohydraulic power sources

2. Shock Hazard

a. Current, not voltage, kills.

(1) Low voltage systems are safer only because the insulation is less likely to break down.

(2) If there is an insulation defect a 12 volt DC system is as deadly as a 400 volt three-phase system.

b. Safety Circuit Breakers (ground fault detectors).

(1) To protect the diver. This type of device should interrupt the current in 25 msec (0.025 sec) in case of a short or at a 5 ma (0.005 amps) if

the insulation is slowly deteriorating.

(2) Commercially available for 110 vac equipment.

(3) A Safety Device suitable for three-phase AC underwater devices is not commercially available.

c. The change of a diver receiving a paralyzing or lethal shock can be reduced by not placing his head or his chest between the electrical device and the ground (usually the work or ship).

d. Fresh water can be more dangerous because the human body is a better conductor than fresh water.

K. Power Actuated Projectile Unit (Stud Gun)

1. Naval Ordinance Laboratory, White Oak, Md. has evaluated two guns for use by Navy:

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
a. Mk 24 or Mk 26 MOD 0 Kit	Show Equipment	Observe and take notes as necessary
(1) Light duty		
(2) 4 types of studs - all 3/8" diameter		
(3) Can be used to 300 ft.		
(4) Operated in any position.		
(5) To be fired underwater, it must be loaded underwater.		
b. Mk 25 or Mk 27 MOD 0 Kit	Show Equipment	
(1) Heavy Duty		
(2) 4 classes of studs from 1/2" to 11/16"		
(3) Can be used to 1000 ft depth		
(4) Operated in any position		
(5) Has 6 detachable barrels.		
(6) Barrels must be loaded topside only.		
(7) Barrels may be connected to drive unit underwater		
2. Several power velocity drivers are commercially available, most of these are designed to install		

3/8 inch diameter and smaller studs. These guns are usually limited to 100 ft. or less underwater.

3. Use

a. Studs are a fast method of installing fasteners. A stud can be installed in 20% of the time it takes to install an equivalent drill and tap fastener.

b. Pullout strength of single studs have averaged 80% of the manufacturer's values.

c. Padeyes and patches requiring more than one stud may not be stronger than a single stud. The firing vibration appears to loosen previously driven studs.

d. The studs are very brittle and will often break off if struck with a hammer or other similar object. Emphasize.

e. Normally, 10% of the studs will fail to

fire, creating an ordinance disposal problem.

f. Power velocity guns must be completely disassembled and cleaned prior to storage.

4. Firing Procedures — Demonstrate without firing. — Observe. Refer to Student Guide for steps to procedures.

a. Open barrel and check for obstructions.

(1) Use barrel cleaning rod.

b. Select proper cartridge for gun and job.

(1) Color coded base

(a) Yellow - 1/2" plywood to 1/4" steel, 1/2" wood to concrete, 1/8" metal to concrete.

(b) Green - 1/4" steel to 1/4" steel, 1/2" plywood to 1/2" steel.

(c) Red - 3/8" steel plate to 3/8" steel plate, 1/2" plywood to 5/8" steel plate.

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(d) Black - 1/2" steel to 1/2" steel

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c. Place cartridge in barrel.

d. Close barrel and pull barrel safety slide closed.

(1) Hold barrel closed.

e. Select proper area to fire stud.

(1) When patching underwater, it is recommended that a 3/16 to 1/4 inch thick rubber gasket be sandwiched between patch plate and vessel, and studs be driven approximately 4 inches apart and edge distance be at least 1 inch. Draw on C/B

(2) Use a centering disc when stud is to be driven into a pre-drilled hole. Place in the recess of muzzle.

(3) Use a head washer in recess of muzzle if fastening thin or soft material to thicker or harder material.

f. Barrel muzzle end must be held perpen-

dicular to work area.

(1) Safety device will not allow firing at angles over 8 degrees.

g. Push gun to work (must have minimum down force of 5 lbs)

h. Pull trigger straight up into handle.

(1) This cocks and fires the gun.

5. Safety Precautions EMPHASIZE

a. Never point a gun, loaded or unloaded at anyone.

b. Never load or fire without checking for obstructions in the barrel.

c. Select proper cartridge for material and gun.

(1) Too heavy a shot will go through material.

d. Always check or know the material to be studded.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
e. Never attempt to drive studs through: (1) Tool or spring steel. (2) Brick, glass, glazed tile or other brittle material. (3) Any material you cannot identify.		
6. Firing		
a. Have each student fire a velocity power driver into plate on surface.	Observe and instruct as necessary. Be especially alert for unsafe practice. Correct immediately.	Each student completes velocity power driver firing procedures as per Student Guide procedures.
III. Summary		
A. Explain projects for the week		
B. Answer questions		Ask questions as necessary

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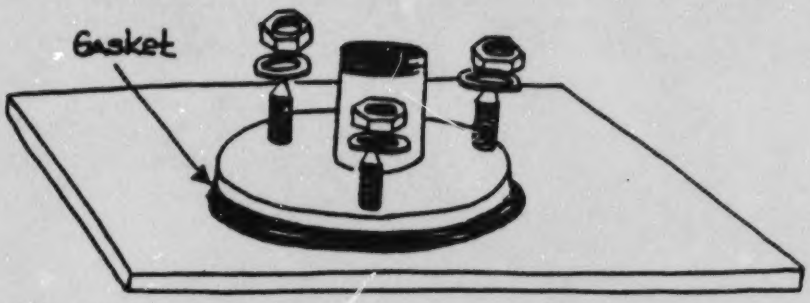
DIVING TRAINING STANDARDS

TASK: Three Hole Flange

UNIT: 1. Underwater Tools



GENERAL DESCRIPTION: Diver will secure a flange to a metal plate using a velocity power driver, test for air leaks, and remove the flange, grinding the securing studs off after removal.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Tank		
2. DEPTH	at least 8 feet		
3. EQUIPMENT	1. Mk 1 Mask System 2. Tool Bag 3. Center Punch		
4. OTHER	4. Hammer 5. Velocity Power Driver 6. Grinder		

(45)

STANDARDS:

1. PERFORMANCE	1. Use proper safety precautions		
2. TIME	20 Minutes		
3. EQUIPMENT	1. No leaks during air test.		

PROCEDURES:

1. Diver descends to the bottom with center punch, hammer, velocity power driver, three hole template, gasket and the required nuts in a tool bag.
2. Diver places the metal template on metal plate and center punches for required three holes.
3. Put studs in place using the velocity power driver.
   a. Diver requests permission for each of the following steps:
      (1) Loading.
      (2) Firing.
      (3) Checking Bore.
      (4) Reloading.
4. Diver secures gasket and flange to metal plate with proper nuts.
5. Diver requests air hose from topside.
6. Diver secures air hose to flange.
   a. Instructor will air test flange for leaks.
7. Diver removes the air hose from the flange.
8. Diver removes flange and gasket from metal plate.
9. Diver requests grinder from topside.
10. Diver removes studs from metal plate with grinder.
11. Diver sends grinder topside and returns to surface.

(46)

WHY DO IT:

To give the student experience in working with underwater tools.

SKILLS NEEDED:

Basic Mechanical

SPECIAL INSTRUCTIONS:

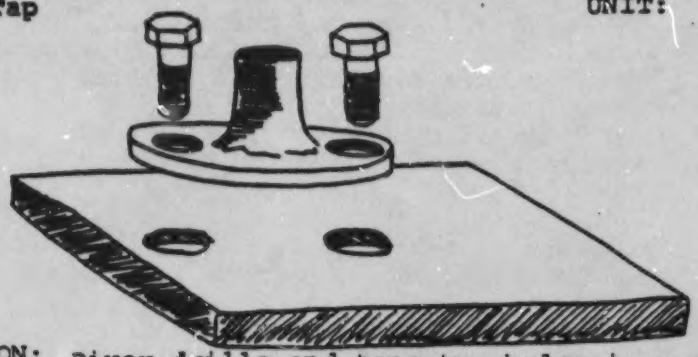
1. Time starts when the diver begins center punching the first hole.
2. Time stops when the diver reports that the project is complete (after grinding off studs).
3. Instructor will insure that strict adherence to safety rules is maintained.

1565

DIVING TRAINING STANDARDS

TASK: Drill and Tap

UNIT: 1. Underwater Tools



GENERAL DESCRIPTION: Diver drills and taps two holes in a metal plate in order to secure a flange. Removes flange and grinds bolts off using grinder.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Tank		
2. DEPTH	at least 8 feet		
3. EQUIPMENT	1. Mk 1 Mask System 2. Hydraulic Drill		
4. OTHER	3. Tool Bag 4. Tap & Wrench 5. Hammer 6. Center Punch 7. Template		

STANDARDS:

1. PERFORMANCE	1. Use proper line-pull signals		
2. TIME	15 Minutes		
3. EQUIPMENT	NONE		

(47)

PROCEDURES:

1. Diver descends to the bottom with tool bag containing equipment used in the project.
2. Diver places template on 1/2" metal plate and center punches for two holes.
3. Drill and tap holes.
4. Secure flange to metal plate with bolts.
5. Remove flange.

WHY DO IT:

To give the student experience in the use of center punch, drill and tap in securing items to metal.

SKILLS NEEDED:

Mechanical

SPECIAL INSTRUCTIONS:

1. Time starts when the diver center punches the first hole.
2. Time stops when the second bolt is ground off flush with the metal project plate.

(48)

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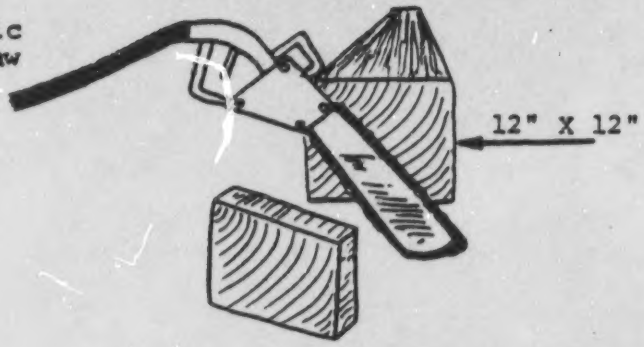
DIVING TRAINING STANDARDS

TASK: Hydraulic Chain Saw

UNIT: 1. Underwater Tools



GENERAL DESCRIPTION: Diver will cut a one inch slab from 12" X 12" timber using the hydraulic chain saw.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Tank		
2. DEPTH	at least 8 feet		
3. EQUIPMENT	1. Mk V System 2. Hydraulic Chain Saw 3. Grease Pencil		
4. OTHER	NONE		

STANDARDS:

1. PERFORMANCE	1. No more than 1/2 inch in angle from start to finish of cut. 2. Use proper safety precautions		
2. TIME	5 Minutes		
3. EQUIPMENT	NONE		

(49)

PROCEDURES:

1. Diver draws a line on the timber using the grease pencil. Line should be one inch from end of the timber.
2. Diver uses proper line-pull signals to receive saw from topside.
3. Diver lines up chain saw with grease pencil line on the timber.
4. Press trigger on chain saw. CAUTION: Chain saw blade must be moving prior to engaging timber.
5. When timber slab floats free, release trigger and send the saw to surface.

WHY DO IT:

To give the student experience in using the hydraulic chain saw underwater.

SKILLS NEEDED:

Mechanical

SPECIAL INSTRUCTIONS:

1. Time starts when diver begins making the line on the timber with the grease pencil.
2. Time stops when the cut slab floats free.
3. Stress safety procedures and operations when using the hydraulic chain saw. Do not hesitate to stop the student should he be conducting himself in an unsafe manner.
4. Cut slab should measure no more than 1 1/2" at any point.

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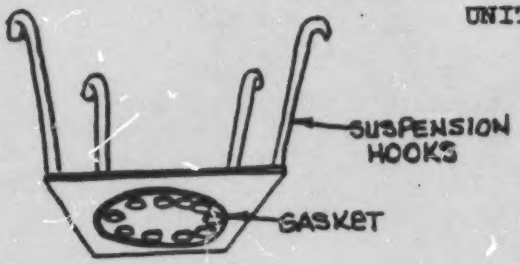
DIVING TRAINING STANDARDS

TASK: Overhead Patch



UNIT: 1. Lightweight Diving

GENERAL DESCRIPTION: Diver removes/replaces patch and rubber gasket suspended from overhead.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Tank		
2. DEPTH	at least 8 feet		
3. EQUIPMENT	1. Mk 1 Mask System 2. Tool Bag 3. Wrench		
4. OTHER	NONE		

STANDARDS:

1. PERFORMANCE	1. Use proper line-pull signals		
2. TIME	24 minutes		
3. EQUIPMENT	1. All nuts and bolts wrench tight		

(51)

1570

PROCEDURES:

1. Diver descends to the bottom and then positions himself on a hogging line.
2. Diver removes 14 bolts and places them in the tool bag.
3. Removing the nuts from the project:
   a. Remove one of the nuts from the project.
   b. Loosen remaining nut in order to allow the patch to drop slightly away from project.
   c. Pull rubber gasket off of stud and swivel gasket 180°.
   d. Push plate back on stud and replace nut covering enough threads to hold the plate in place.
   e. Remove remaining loosened nut from project and remove gasket.
   f. Hold gasket out of water so that the instructor can see it.
   g. Replace the gasket by reversing the removal process.

WHY DO IT:

This gives the student experience in working with patching jobs found on the bottom of most vessels. Provides experience in working on hogging line and having the job above the diver.

SKILLS NEEDED:

Basic Mechanical
Proficiency in the use of the Mk 1 Diving System

SPECIAL INSTRUCTIONS:

1. Time starts when the diver places the wrench on the first bolt.
2. Time stops when the diver reports that the project is complete.

(52)

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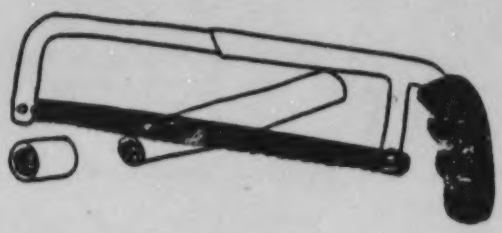
DIVING TRAINING STANDARDS

TASK: Hacksaw



UNIT: 1. Lightweight or Underwater Tools

GENERAL DESCRIPTION: Diver cuts off piece of metal using a hacksaw from either a piece of pipe or angle iron.

CONDITIONS:	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Tank		
2. DEPTH	at least 8 feet		
3. EQUIPMENT	1. Mk 1 Mask System 2. Hacksaw		
4. OTHER			

STANDARDS:			
1. PERFORMANCE	NONE		
2. TIME	7 minutes		
3. EQUIPMENT	NONE		

(53)

1812

PROCEDURES:

1. Diver positions angle iron or pipe on work bench.
2. Saw through the project angle iron or pipe using a hacksaw. Cut approximately one inch off main project metal.

WHY DO IT:

This will give the student experience in using the hacksaw underwater.

SKILLS NEEDED:

Mechanical

SPECIAL INSTRUCTIONS:

1. Time starts when diver begins cutting.
2. Time stops when diver finishes cut.
3. Time will continue in the event a blade change is required.
4. Caution divers not to use two hands or apply too much pressure to the saw. Either will cause the blade to break, thus causing delay.

NOTE: This project is to be used in instances when class size is small enough or the class is proficient enough to have time remaining in the unit after all required projects/classroom have been completed.

(54)

GPO 901-276

NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022
Ship Salvage Diving Officer A-4N-0011
Deep Sea (HeO2) Diving Officer A-4N-0010

Security Clearance: Unclassified

Lesson Topic: 10.1 Underwater Cutting and Welding

30 Hours

INSTRUCTIONAL MATERIALS:

NAVSHIPS 0929-000-8010
U.S. Navy Diving Manual, Vol. I
Student Guides
Standard Classroom Equipment
D.C. Welding Generator
Knife Switch, Type K Infusible
Welding Cable, Size 2/0
Welding Cable, Size 1/0
Type TRXF, 10 ft. Attached to holder
Male Connector
Female Connector
Supplementary Faceplate
Grouping Clamp
Weighted Wire Brush
Chipping Hammer
Scraper
Electrodes
Electrode Waterproofing Materials
Steel Tubular Electrodes
Ceramic Electrodes
Oxygen Waterproofing Materials
1. Celluloid
2. Acetone
3. Waterproof laquer

INSTRUCTIONAL MATERIALS (cont'd)

Oxy-hydrogen Underwater Cutting Torch
Hose, 5/16" ID, red, green, and black
Oxygen Regulator
Hydrogen Regulator
Underwater oxy-hydrogen cutting-torch igniter
Valve Wrench
Protective Clothing
Oxygen in Cylinders
Compressed Air
Diving Tool Bag
Steel Plate
Mk V Deep Sea Diving System w/gloves
O2 Manifold
Work Bench w/clamp
Films MN7851A, MN7851B, MN7851C
Diving Underwear

TERMINAL OBJECTIVES

1. When the student completes this course he will be able to, in an open tank with at least eight feet of water, using the Mk V Deep Sea Diving System, successfully complete any three of the following projects in accordance with Diving Training Standards: Oxygen Arc Cutting (Ceramic Rod), Oxygen Arc Cutting (Steel Tubular Rod), Shielded Metal Arc Cutting, Shielded Metal Arc Welding.

ENABLING OBJECTIVES

1. DEFINE/EXPLAIN, in writing, terms relative to underwater cutting and welding.

ENABLING OBJECTIVES (cont'd)

2. Orally DESCRIBE the types of cutting and welding that will be used in completion of the projects during this unit.

3. DESCRIBE, in writing, the various materials used in underwater cutting and welding.

4. Orally EXPLAIN the function(s) of the various methods of underwater cutting and welding used in completion of the projects for this unit.

5. For each of the types of underwater cutting and welding used in completion of the projects during this unit:
   a. EXPLAIN, in writing, the function(s) of the component parts in terms of what they do for the individual components.
   b. DESCRIBE, by illustration, the physical location of the component parts within each of the major components.
   c. Orally EXPLAIN how the component parts carry out their function(s).
   d. LIST, in writing, the ratings and specifications of selected component parts.
   e. DESCRIBE, by illustration, the source(s) of power for selected component parts.
   f. Orally DESCRIBE the protection

ENABLING OBJECTIVES (cont'd)

provided the system by applicable component parts.
g. DESCRIBE, in writing, the major materials used in construction of selected component parts, and EXPLAIN why the particular materials are used.

6. DESCRIBE, in writing, the important features of each of the various cutting processes used to complete the projects of this unit.

7. Orally DESCRIBE the procedure for determining the polarity of a welding generator if polarity markings are illegible.

8. Orally EXPLAIN a simple schematic diagram of a typical arrangement for oxygen arc cutting.

9. Orally EXPLAIN the preparation of an emergency tubular electrode.

10. DESCRIBE, in writing, the advantages of steel tubular electrodes versus the advantages of ceramic tubular electrodes.

11. Orally DESCRIBE cutting techniques for oxygen arc for thick and thin steel plate using the steel tubular electrodes.

ENABLING OBJECTIVES (cont'd)

12. DESCRIBE, in writing, the principle of operation for shielded metal arc cutting.

13. DESCRIBE, in writing, the proper metallic arc cutting technique for steel plate less than 1/4 inch thick and for plates greater than 1/4 inch thick.

14. EXPLAIN, in writing, the advantages of oxygen hydrogen cutting.

15. Orally EXPLAIN why hydrogen and not acetylene is used as a fuel gas.

16. DESCRIBE, in writing, the principle of operation in oxygen hydrogen cutting.

17. EXPLAIN, orally and in writing, procedure for lighting the oxygen hydrogen torch underwater.

18. EXPLAIN, orally and in writing, the techniques for starting and advancing the cut with an oxygen hydrogen torch.

19. DESCRIBE, in writing, the principle of operation for shielded metal arc welding.

20. DESCRIBE, in writing, the largest diameter electrode recommended for shielded metal arc welding operation.

ENABLING OBJECTIVES (cont'd)

21. DESCRIBE and DEMONSTRATE the preparation of an underwater surface for welding.

22. DESCRIBE, orally and in writing, the importance of the welding current setting.

23. STATE, in writing, the setpoint(s) and reasons for the setpoint(s) in terms of operating above or below them for:
    a. Figuring correct gas pressure at depth.
    b. Polarity.

24. DESCRIBE, in writing, and DEMONSTRATE safety precautions unique to underwater cutting and welding:
    a. Trapped explosive gases.
    b. Placing the diver between the ground and electrode.

25. Given a job analysis sheet for each project to be completed during this unit, orally EXPLAIN the following aspects of the project:
    a. What the project is.
    b. The conditions under which the project will be completed.
    c. Standards which will determine success.
    d. How to perform the project successfully.
    e. How each project relates to a fleet diving job.

ENABLING OBJECTIVES (cont'd)

f. Particular skills necessary for the successful completion of the project.

26. In an open tank with at least eight feet of water, using the Mk V Deep Sea Diving System, PRACTICE each of the underwater cutting methods used in completion of the projects for this unit. As many as three electrodes (one ceramic) may be used for practice (determined by the student).

CRITERION TEST

1. In an open tank with at least eight feet of water, using the Mk V Deep Sea Diving System, successfully complete any three of the following projects in accordance with Diving Training Standards: Oxygen Arc Cutting (Ceramic Rod), Oxygen Arc Cutting (Steel Tubular Rod), Shielded Metal Arc Cutting and Shielded Metal Arc Welding.

HOMEWORK

DAY 1 - Information Sheet: 10-1-1I
Assignment Sheet: 10-1-1A through 10-1-6A
Job Steps: 10-1-1J through 10-1-5J

HOMEWORK (cont'd)

DAY 2 - Assignment Sheet: 10-1-7A through 10-1-8A
DAY 3 - Assignment Sheets: 10-1-9A through 10-1-11A
Review Job Sheets as necessary
DAY 4 - Assignment Sheet: 10-1-12A through 10-1-14A
Review Job Sheets as necessary
DAY 5 - Assignment Sheet: 10-1-15A through 10-1-16A
Review Job Sheets as necessary

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction		
A. Establish Contact	Introduce self and topic	
B. Establish Readiness	Get Student ready to learn Classroom procedures, etc.	
C. Establish Effect	Bring out need and value of material	
D. Overview	State Learning Objectives	
II. Presentation		
A. Define terms relative to underwater cutting and welding	Use C/B or transparency	Take notes as necessary.
1. Arc - a short circuit between the electrode and the work.		
2. Ground - positive pole on a welding machine.		
3. Connectors - a means of connecting two welding leads (50') together.		
4. Ignite - producing sufficient heat to light a torch.		
5. Shielded - covered. Shielded Metal Arc Cutting - cutting with covered electrodes.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
6. Polarity - direction of current flow. a. Straight Polarity - from negative to positive. 7. Switch On/Off - the position of the knife switch giving the diver power to the electrode holder. 8. Waterproofing - to protect the covering from deterioration by seawater. 9. Cut/Burn Ratio - 1 linear inch of metal cut per inch of electrode consumed. 10. Flashback - a recession of the flame into or back of the mixing chamber of the torch. 11. Kerf - the space from which the metal has been removed by a cutting process.		
B. Oxygen, Hydrogen Cutting 1. Classified as Oxygen cutting process. 2. Rapid Oxidation or Rusting.	Prior to #2, show movie on Oxy-Hydrogen Cutting. Use actual equipment, transparency or chart.	Observe and take notes as necessary.

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OUTLINE OF INSTRUCTION INSTRUCTOR ACTIVITY STUDENT ACTIVITY

3. Metal brought to kindling temperature with O2 and Hydrogen.
4. Jet of pure O2 directed at heated area cuts metal rapidly.
5. Cutting Torch
   a. Type
      (1) Victor, Harris 28, Airco, KG
   b. Construction
      (1) Hydrogen Knob
      (2) Oxygen Knob
      (3) Compressed Air Knob
      (4) Mixing Chamber
      (5) Air Jacket
      (6) Distance Shoe 3/16"
   c. Tips
      (1) Size depends upon thickness of metal being cut.
      (2) Tips not interchangeable.
      (3) Pg 5-6 Welding & Cutting Manual for chart on sizes.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
6. Hoses		
a. Oxygen Hose		
(1) Green		
(2) Size - 5/16" ID, 9/16" OD		
(3) Not to be used on O2.		
(4) Right-Handed thread		
b. Air Hose		
(1) Black		
(2) Size - 5/16" ID, 9/16" OD		
(3) Not to be used on O2		
(4) Right-Handed Threads		
c. Hydrogen Hose		
(1) Red		
(2) Size - 5/16" ID, 9/16" OD		
(3) Left-Handed Threads, Notched	Show notched fittings	
7. Regulators	Show O2 and Hydrogen regulators	
a. Oxygen Regulator		
(1) Two stage - hand controlled		
(2) 0-3000HP, 0-100LP		

(3) To reduce bottle pressure to desired pressure.

(4) Right-Handed thread

(5) Use for O2 only.

b. Air Regulator

(1) Same as O2 regulator

(2) Not for use on O2.

c. Hydrogen Regulator

(1) Two stage - hand controlled

(2) 0-2500HP, 0-100LP

(3) To reduce bottle pressure to desired pressure

(4) Left-Handed Threads

(5) Notched Fitting

8. Igniter

a. Electrical Igniter — Show electrical igniter

(1) Lighting oxy-hydrogen torch underwater.

(2) Preferred method of lighting torch.

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

(3) Power Supply - 120 volts

(4) Must have a ground

(5) Spark through to electric contacts.

(6) Must be dressed in D/S Dress before using.

b. Friction Lighter — Show friction lighter

(1) For lighting torch topside

(2) Same as one used for lighting Acetylene torch.

9. Oxygen-Hydrogen Torch

a. Advantages

(1) Flectric current is not necessary.

(2) Shallow water equipment can be used.

(3) Equipment portable - can be used in a small boat.

(4) Can cut line or cable easily.

b. Disadvantages

(1) Hydrogen is undesireable deck cargo.

OUTLINE OF INSTRUCTION INSTRUCTOR ACTIVITY STUDENT ACTIVITY

10. Oxygen-Hydrogen Torch
    a. Acetylene
        (1) Underwater use for emergency only.
        (2) Considered unsafe at pressures above 15 psi.
11. Principle of operation
    a. Cutting metal by means of the chemical reaction of O2 with the metal at elevated temperatures.
    b. Temperature maintained by means of gas flame obtained by a bubble of air from torch.
12. Oxygen Hydrogen Torch
    a. Lighting underwater
        (1) Open air to a 3" bubble, note setting, then secure.
        (2) Open hydrogen to a 3" bubble, note setting, then secure.
        (3) Open oxygen to a 2 1/2" bubble, leave open.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(4) Open Air and Hydrogen to previous settings.		
(5) Light with electric igniter.		
(6) NOTE: If torch is moved more than 20', must be readjusted.	Explain depth adjustment	
13. Oxygen Hydrogen Torch		
a. Starting cut and advancing		
(1) Insure proper flame		
(2) Place distance shoe on metal to be cut.		
(3) Hold torch in one place to preheat metal.		
(4) Press O2 Trigger.		
(5) Pull torch along desired line of cut.		
14. Oxygen Hydrogen Cutting		
a. Safety Precautions		
(1) Ventilate compartment and adjacent compartment into which cut is being made:		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(a) Vents off gases		
(b) Drill hole in top of compartment.		
(2) Gases Encountered		
(a) Gasoline		
(b) Fuel Oil		
(c) Paint		
(d) Ammo		
(e) Hydrogen Sulphide		
(f) Unburned Hydrogen from torch.		
(3) Falling pieces of metal being cut.		
(4) Shock from electric igniter.	Review Oxy-Hydrogen Torch and process.	
C. Oxygen Arc Cutting	Prior to #3, Show movie of Oxygen Arc Cutting and Welding process.	
1. Oxy Arc Cutting Process		
a. Rapid Oxidation or Rusting		
b. Arc maintained by a straight polarity DC electric current.		
c. O2 forced through hole in rod to cut metal.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. Standard Navy Cutting Electrode Holder		
a. Nomenclature		
(1) #200 modified 1/4 Globe Valve		
(2) Oxygen Trigger		
(3) Made of 1/4" ID pipe fittings		
(4) Check Assembly		
(5) Insert for tubular rod.		
b. Function		
(1) Designed to grip electrode.		
(2) Delivers power to electrode.		
c. Safety Precautions	Draw on C/B. Show electrode holder.	
(1) Must be completely insulated.		
(2) Power to electrode holder only when diver is cutting.		
(3) Only one approved for underwater work can be used.		
(4) Do not use springless type.		
(5) Inspection of the electrode holder should be made prior to each operation.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(6) Never hold the electrode so that it will be pointed toward the diver.		
(7) Never get between the electrode holder and the ground.		
(8) Never change electrodes in the holder when the current is on.		
3. Electrodes		
a. Steel Tubular Cutting	Pass Around steel tubular rod	
(1) Steel Tube		
(a) 14" long, 5/16" dia., 1/8" bore.		
(2) Waterproof Flux Covering		
(a) Ct Pink Waterproofing.		
(b) Other types		
(3) Steel tubes used because high melting point.		
(4) Flux covering similar to that on welding rod.		

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

(5) Purpose of Flux

(a) Promotes easy starting and maintenance of the arc.

(b) Forms and maintains a protective sleeve around the arc.

(c) Serves as electric insulator.

(d) Prevents arcing from the side of electrode.

(e) Flux is waterproofed by manufacturer dipping them in a thermoplastic laquer.

(6) Advantages

(a) Cutting technique is simple and readily mastered.

(b) Ease of operation for all thicknesses of metal being cut.

(c) Rapid rate of cutting.

(d) Neat and trim cut.

(e) Power requirement is within a

300 amp welding generator.

(f) Superior to ceramic rod cutting up to 3/4" because of cost.

(7) Technique

(a) Seat electrode in holder firmly against rubber gasket.

(b) Make dry run.

(c) Hold electrode perpendicular to surface to be cut.

(d) Use dragging motion.

(e) Non-ferrous metals over 1/4" thick, use sawing motion.

(f) Pressure exerted in two directions - down to compensate for burning off and forward to advance the cut.

(g) Over 1/4" thick metal, 90°

(h) Under 1/4" thick metal, 45°

(i) Use air instead of O2 when cutting non-ferrous metals.

(8) Emergency Use

(a) 5/16" heavy walled steel tube.

(b) 1/8" extra strong iron pipe.

(c) Both will be 14" length.

(d) Cover complete rod except that which fits in electrode holder.

1. 3 wraps of masking tape, or

2. 4 wraps of newspaper, or

3. 3 wraps of wrapping paper, or

4. 4 wraps of writing paper

(e) Same power source and machine setting is used.

b. Ceramic Tubular Cutting Show ceramic rod

(1) Silicon Carbide Tube

(a) 1/2" dia, 8"long, 1/8" bore.

(b) 1/32" steel sheath sprayed on.

(c) Electrical sleeve saturated with waterproofing material.

(d) One end ground to 0.525" dia. for electrode holder.

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

(2) Advantages

(a) Longer life due to slow burn off rate.

(b) Length allows to work in confined spaces.

(c) Lightweight

(d) Service life 10-12 minutes.

(3) Disadvantages

(a) Brittle and easily broken

(b) Expensive

(4) Technique

(a) same as Steel Tubular

(b) Do not apply a great deal of pressure to rod.

Review Oxy Arc Cutting

c. Shielded Metal Arc Cutting

(1) A method of metal arc cutting.

(a) Effected by melting with the heat of an arc and pushing metal away.

(b) No O2 needed.

(c) Standard welding electrode holder used.

(d) Superior to O2 cutting when cutting plate less than 1/4". Explain

(e) Superior when cutting non-ferrous metals.

(f) Temperature ranges from 8,000 to 80,000.

(g) Generator amps must be higher than in welding.

(h) Same equipment used as in welding.

D. Underwater Welding

1. Welding Electrodes

a. Sizes

(1) 3/16" or 5/16"

(2) Depends upon metal being welded.

(3) Larger size recommended.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
b. Waterproofing		
(1) Sealac		
(2) Ucilon		
(3) Celluoid 1/2 lb, 1 gal acetone		
(4) Clear laquer		
(5) Dip rods in completely.		
(6) Allow 24 hrs to dry.		
(7) Grind both ends for good contact.		
(8) Filler metal electrode used in arc welding.	Show welding electrode	
(a) Has thick covering which provides protection for the molten metal from the atmosphere.		
1. Improve the properties of weld material.		
2. Stabilizes the arc.		
c. Types Recommended		

(1) Same as used for topside except for waterproofing.

(a) Westinghouse Sw

(b) Alternex

(c) Fleet Weld 37

1. Lincoln Manufacturer

(2) All are Navy grade III Type for AC/DC all position welding.

2. Uses and Limitations

a. Weld small patches.

b. Welding cracks, seams and butts.

c. Welding leaking rivets.

d. Must not be of irregular shape.

e. Patches must be made to fit contour of hull.

f. No cap over 1/16".

g. Thickness of patch is of no value if primary support structure has been weakened.

Emphasize

(22)

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
b. Any weld Underwater is temporary.	Emphasize	
3. Techniques		
a. Flatweld "Fillet"		
(1) Set current		
(2) 15 to 45 degree angle		
(3) Self-consuming method		
(4) Slight downward pressure		
(5) Most desireable		
b. Vertical Weld		
(1) Set current		
(2) 15 to 45 degree angle		
(3) Self-consuming method		
(4) Slight pressure 90 degrees from position of weld.		
c. Overhead Weld		
(1) Set current		
(2) 35 to 55 degree angle		
(3) Self-consuming method		

4. Power Cable

a. Used to deliver current from generator to electrode holder.

b. Cable Lead

(1) Size 2/0 minimum size recommended.

(2) 50 ft. length to prevent excessive voltage drop.

(3) Type TRXF MI C-915.

(4) Electrode Holder last 10 feet 1/0

(a) Gives diver flexibility in maneuvering the electrode holder.

(5) All connectors should be taped for complete insulation.

(6) Contact resistance kept to a minimum by insuring connectors are tight and clean.

(7) Poor insuluation causes current leakage, and rapid deterioration of the copper cable.

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

5. Ground Cable

   a. Same size must be used as the lead.

   b. Positioned as close to work as possible.

   c. Positioned so the diver WILL NOT get BETWEEN THE GROUND AND THE WORK. EMPHASIZE

   d. Must be the positive side of generator.

6. Knife Switch

   a. Positive operating disconnecting safety switching electrode lead. — Show actual equipment, transparency or chart.

      (1) Electric welding or cutting

      (2) Protects diver

      (3) Switch is on only when diver is welding or cutting.

      (4) Switch is off when changing electrodes.

      (5) Single pole, single throw 300 amp 250 volts K type.

      (6) Position so that it cannot be

accidently engaged.

(7) Switch must be in a closed position to operate.

(8) Phone Talker will operate Knife Switch, and have NO OTHER JOB. EXPLAIN and EMPHASIZE

7. Generators

a. Power supplied to electrode for welding and cutting.

b. At least 300 amp capacity.

c. AC Current not recommended.

(1) Dangerous

(2) Greater skill required.

d. DC Current recommended

(1) Arc easier to maintain.

e. Straight Polarity Reminder: "BF positive you have a ground"

(1) Ground is positive

(2) Electrode Negative

(3) Current flows from work to electrode.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
f. Reverse Polarity		
(1) Should not be used.		
(2) Cause deterioration of electrode holder and lead.		
g. Determining Correct Polarity	Demonstrate, if possible	
(1) Secure Generator		
(2) Connect electrode to ground cable		
(3) Insert electrode in holder		
(4) Place the tips of both electrodes in a container of salt water.		
(5) Be sure operator is properly insulated.	EMPHASIZE	
(6) Light off generator.		
(7) Hold the tips one or two inches apart.		
(8) Bubbles will flow from the negative pole.		
(9) Practically none will flow from the positive pole.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
h. Types		
(1) Lincoln		
(2) Hobart		
(3) Westinghouse		
i. Generators Cutting		
(1) 400 amp capacity		
j. Wet Suit		
(1) Emergency use only when welding or electrical cutting.		
(a) Must be free of holes and tears.		
(b) Not compressed below 50' wet.		
(c) Can be used only once.		
III. Summary and Questions		Ask questions as necessary

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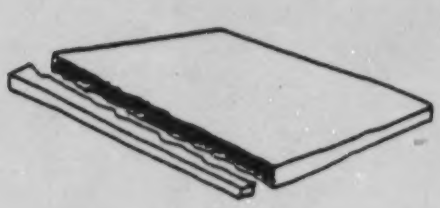
DIVING TRAINING STANDARDS

TASK: Oxy-Arc Cutting (Ceramic)



UNIT: 1. Underwater Cutting and Welding

GENERAL DESCRIPTION: Diver will make a cut in steel plate using the oxy-arc method and ceramic electrodes.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Tank		
2. DEPTH	at least 8 feet		
3. EQUIPMENT	1. Mk V System 2. Oxy-arc Cutting Torch 3. Ceramic electrodes		
4. OTHER	4. Tool Bag 5. Crescent Wrench and/or hammer 6. Wire Brush		

STANDARDS:

1. PERFORMANCE	NONE		
2. TIME	NONE		
3. EQUIPMENT	1. Following lengths of cut: 7"/3/8" to 5/8" plate 6"/3/4" plate		

(29)

PROCEDURES:

1. Position project plate on work bench with C-clamp.
2. Attach ground clamp to project plate.
3. Request electrode holder from topside.
4. Clean area of project plate where cut is to be made with a wire brush or scraper.
5. Insert the electrode in the electrode holder.
6. Place electrode on the project plate on the location where the cut is to be made.
7. Close supplementary face plate.
8. Squeeze oxygen trigger.
9. Call for "Switch on."
10. Make the cut.
11. Lift the electrode from the project plate.
12. Call for "Switch off."
13. Put cut project plate in tool bag and return to the surface.

WHY DO IT:

This skill is required for emergency rescue and salvage operations.

SKILLS NEEDED:

Basic mechanical

SPECIAL INSTRUCTIONS:

1. Student will get only one (1) ceramic electrode for use in practice and project work. One inch may be used for practice and any of the required cuts should take no more than one inch.
2. Students should attempt to make their cut within 1/2" on the edge of the project plate.
3. Students may use a wrench or hammer to help separate the cut plate from the main plate.

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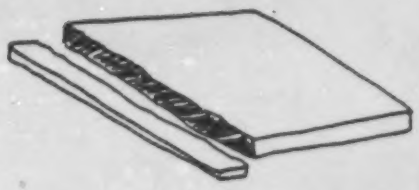
DIVING TRAINING STANDARDS

TASK: Oxy-Arc Cutting (Steel Tubular)



UNIT: 1. Underwater Cutting and Welding

GENERAL DESCRIPTION: Diver will make a cut in steel plate using the oxy-arc method and steel tubular electrodes.

CONDITIONS:	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Tank		
2. DEPTH	at least 8 feet		
3. EQUIPMENT	1. Mk V System 2. Oxy-arc Cutting Torch 3. Steel Tub. Electrodes		
4. OTHER	4. Tool Bag 5. Crescent Wrench and/or hammer. 6. Wire Brush		

STANDARDS:			
1. PERFORMANCE	NONE		
2. TIME	NONE		
3. EQUIPMENT	1. Following lengths of cut: 10"/1/4" plate 8"/3/8" plate 6"/1/2" plate		

(31)

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PROCEDURES:

1. Position project plate on work bench with C-clamp.
2. Attach ground clamp to project plate.
3. Request electrode holder from topside.
4. Clean area of project plate where the cut is to be made with a wire brush or scraper.
5. Insert the electrode in the electrode holder.
6. Place electrode on the project plate on the location where cut is to be made.
7. Close supplementary face plate.
8. Squeeze oxygen trigger.
9. Call for "Switch on."
10. Make the cut.
11. Lift the electrode from the project plate.
12. Call for "Switch off."
13. Put cut project plate in tool bag and return to surface.

WHY DO IT:

This skill is required for emergency rescue and salvage operations.

SKILLS NEEDED:

Basic mechanical

SPECIAL INSTRUCTIONS:

1. Student will get three electrodes for practice, if necessary. This is to be determined by the student. For example, he may practice with one electrode, determine that he can make the cut, and inform the instructor that the next cut will be for score.
2. Students should attempt their cut within 1/2" of the edge of the project plate.
3. Students may use a wrench or hammer to help separate the cut plate from the main plate.
4. One electrode will be used for the final cut.

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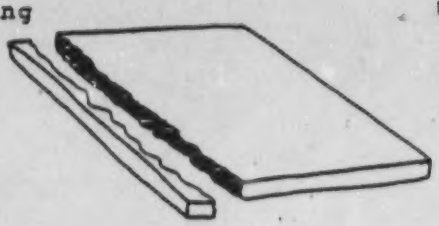
DIVING TRAINING STANDARDS

TASK: Metallic Arc Cutting (Shielded)



UNIT: 1. Underwater Cutting and Welding

GENERAL DESCRIPTION: Diver will make a cut in steel plate using the metallic arc process.

CONDITIONS:

	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Tank		
2. DEPTH	at least 8 feet		
3. EQUIPMENT	1. Mk V System 2. Tool Bag 3. Electrode Holder		
4. OTHER	4. Shielded Metal Arc Electrodes. 5. Crescent wrench and/or hammer 6. Wire Brush		

STANDARDS:

1. PERFORMANCE	NONE		
2. TIME	NONE		
3. EQUIPMENT	See Special Instructions on Reverse		

(33)

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PROCEDURES:

1. Position project plate on work bench with C-clamp.
2. Attach ground clamp to project plate.
3. Request electrode holder from topside.
4. Clean area of project plate where the cut is to be made with a wire brush or scraper.
5. Insert electrode into electrode holder.
6. Place electrode on the project plate on the location where cut is to be made.
7. Close supplementary face plate.
8. Call for "Switch on."
9. Make the cut.
10. To stop cut, lift electrode away from project plate.
    a. leave a minimum of 3" of electrode not consumed to avoid damaging the electrode holder.
11. When cut is completed, call for "Switch off."
12. Put cut project plate in the tool bag and return to the surface.

WHY DO IT:

This skill is necessary for emergency rescue and and salvage operations.

SKILLS NEEDED:

Basic Mechanical

SPECIAL INSTRUCTIONS:

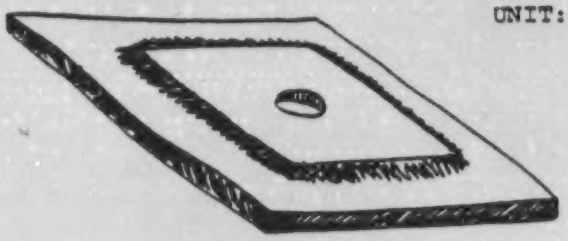
1. Students will get three electrodes for practice, if necessary. This is to be determined by the student. For example, he may practice with one electrode, determine that he can make the cut, and inform the instructor that the next cut will be for score.
2. Students should attempt their cut within 1/2" of the edge of the project plate.
3. Students may use a wrench or hammer to help separate the cut plate from the main plate.
4. 300 amps current using 3/16" electrodes.
   400 amps current using 1/4" electrodes.
5. Standards: Student must make one of the following cuts:
   a. Using 3/16" electrodes:
   1/4" plate - minimum of 3" using one electrode.
   3/8" plate - minimum of 2" using one electrode.
   1/2" plate - minimum of 1" using one electrode.
   b. Using 1/4" electrodes:
   1/4" plate - minimum of 5" using one electrode.
   3/8" plate - minimum of 3" using one electrode.
   1/2" plate - minimum of 2" using one electrode.

(34)

1607

DIVING TRAINING STANDARDS

TASK: Welding a Patch



UNIT: 1. Underwater Cutting and Welding

GENERAL DESCRIPTION: Diver will weld a steel patch on a steel plate and air test the weld for leaks.

CONDITIONS:	UNIT 1	UNIT 2	UNIT 3
1. ENVIRONMENT	Open Tank		
2. DEPTH	at least 8 feet		
3. EQUIPMENT	1. Mk V System 2. Welding Electrode holder 3. Wire brush		
4. OTHER	4. Chipping Hammer 5. Crescent wrench		

STANDARDS:			
1. PERFORMANCE	NONE		
2. TIME	NONE		
3. EQUIPMENT	1. No more than twelve holes under air pressure.		

(35)

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PROCEDURES:

1. Position 6" X 6" project plate in clamping device at 45°.
2. Install grounding clamp on project plate.
3. Request electrode holder from topside.
4. Diver positions himself in welding position, insert electrode into electrode holder. CAUTION: Do not touch any part of diving outfit with the electrode.
5. Diver places the electrode on steel project plate in position of desired weld and closes supplementary face plate.
6. Call for "Switch on."
7. Make weld across the plate.
8. Call for "Switch off".
9. Use a wire brush to clean the weld and then inspect it.
10. Using the above procedures (4 through 9), make a second weld at 90° of first weld and in such a manner as to pass over the first weld.
11. Make a third weld as above except that the weld must pass over intersections of welds 1 and 2.
12. Turn project plate over and center 4" X 4" plate on 6" X 6" plate and clamp them together.
13. With a new electrode, diver makes the first weld down the remaining side - top to bottom on either side.
14. Using a new electrode, make the second weld down the remaining side - top to bottom.
15. Using new electrodes for each weld, make passes three and four.
16. Reinforce each corner as in practice step 11, above.
17. Remove welded plates from clamping device, secure in tool bag, and return to the surface.

(36)

WHY DO IT:

This is a required skill for performing underwater repairs to steel vessels and for salvage and rescue operations.

SKILLS NEEDED:

Basic Mechanical

SPECIAL INSTRUCTIONS:

1. Student will get only one practice electrode.
2. Once the project plates are clamped into position, they must not be moved until the project is complete.

1999

GPO 901-477

NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022

Security Clearance: Unclassified

Lesson Topic: 11.1 Mk V Deep Sea Diving System Helmet

7 Hours

INSTRUCTIONAL MATERIAL:

U.S. Navy Diving Manual, Vol. I
Standard Classroom Equipment
Student Guides
Mk V Deep Sea Diving System Helmet
Slotted 8" Screwdriver
Hand Wire Brush
Litharge and Glycerin 60/40
Breastplate Gasket Mandrel
Block of Wood and Sandpaper
Knife or Scribe
Breastplate Studs
50/50 Soft Solder
Propane Torch
Flux
1/2" Die

TERMINAL OBJECTIVE

1. When the student completes this course he will be able to, given a Mk V Deep Sea Diving System Helmet, perform the following maintenance so that the equipment may be used in diving operations: Replace port glass, replace breastplate gasket, and replace breastplate stud. Additional maintenance items

1893

TERMINAL OBJECTIVES (cont'd)

are to be accomplished dependent upon time, and equipment requirements.
a. Replace breastplate padeye.
b. Replace telephone jack in gooseneck.
c. Replace reproducer.
d. Chase threads on the Air Gooseneck, Telephone Gooseneck and Breastplate Studs.
e. Replace safety locking device.
f. Replace or lap in the Supplementary Exhaust Valve.
g. Lap in and adjust the Exhaust Valve.
h. Replace face plate and gasket.
i. Test communications.
j. Make new lanyards for the breastplate eyelets and install them.

ENABLING OBJECTIVES

1. For each of the repairs/maintenance requirements listed above:
a. Orally STATE the common cause(s) of the equipment damage/failure/leak which would lead to repairing or replacing the specific piece of equipment.
b. LIST, in writing, the tools needed for the specific repair.
c. EXPLAIN, in writing, step-by-step procedures for effecting the repair or replacement.

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ENABLING OBJECTIVES (cont'd)

d. Orally EXPLAIN the importance of doing proper repairs--inciuding results if repair procedures are not carried out properly.

CRITERION TEST

1. Given a Mk V Deep Sea Diving System Helmet, perform the following maintenance so that the equipment may be used in diving operations: Replace port glass, replace breastplate gasket, and replace breastplate stud.

HOMEWORK

Student Guide, Volume K
Assignment Sheets 11-1-1A through 11-1-2A.

1895

Tools for Mk V Deep Sea Diving System Equipment and Repair

Slotted 8" Screwdriver
Wire Brush
Litharge and Glycerin 60/40
Breastplate gasket mandrel
Block of wood and sandpaper
Knife or scribe
New B/P stud, 1 3/4" or 2 1/2"
50/50 soft solder
Propane Torch Flux
Breastplate stand
1/2" die (12 thread)
Clean rags
Padeye and backing plate
File and hammer
Slotted 6" screwdriver
Open-end wrench
Beeswax and laddle
Voltimeter
#8-32 thread screws
Telephone test box (diver's amp)
Punch
Drift pin
1" open end wrench
New springs
Bright work polish
12" adjustable wrench
Needle nose pliers
3/8" halyard
Sail twine, needle, palm
LP air supply (150 psi)
Chalk
#4 B.F. Goodrich glue
5 3/4" to 3 1/2" D/C plug
Roller
Trichloretholyne
Scissors
D/S diving Gloves
Patch templates
Patching material
#2B grommets
#2B grommet die
3/8" gasket punch
Stud shim
Neets Foot Oil
Marline
Air control valve
#6 canvas
Paint
1/8" line white
Spanner wrench
Wire cutter and stripper
Wood screw
"T" wrench
Flax packing

Tools needed for individual jobs are not listed in the instructor guides but will be referred to in the procedures for those jobs.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction to the lesson.		
A. Establish Contact	Introduce self and topic.	
B. Establish Readiness	Get students ready to learn.	
C. Establish Effect	Bring out need and value of material.	
D. Overview	State learning objectives.	
II. Mark V Deep Sea Diving System Helmet		
A. Replace Port Glass	Use Helmet T/A.	
1. Failure Due to:		
a. Glass breaking.		
b. Litharge and glycerin seal breaking.		
2. Procedures:	Demonstrate using actual equipment or T/A.	Observe. Take notes as necessary.
a. Remove faceplate guard; four 8-32 3/8" machine screws.		
b. Remove old glass.		
c. Clean faceplate on port with wire brush and scraper.		
d. Prepare litharge and glycerin	Mixture change dependent	

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
mixture.	upon temperature and humidity. Do not let come in contact with skin.	
e. Place mixture liberally in port ring.		
f. Place new glass (or cleaned one) in port ring and tap in place.		
g. Scrape off excess litharge mixture and wipe and clean with rag.		
h. Replace port or faceplate guard and allow to dry at least eight (8) hours prior to use.	Testing this particular terminal objective may be accomplished by: 1. Having the student actually perform the work on a helmet needing repair or a designated T/A helmet, or 2. Have the student describe the necessary steps while demonstrating as much as possible.	
3. Practical work.		
a. Each student should accomplish these procedures.		
B. Replace breastplate gasket.		
1. Failure due to:	Gasket T/A.	Pass T/A around.
a. Leather worn--age.	Show class two reasons for gasket--use T/A.	
b. Improper care.	1. Control travel of helmet.	
c. Can be shimmed up. (3) shims	2. Watertight seal	
(1) chart paper.		

1889

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
d. Improper storage.		
2. Procedures:	Use T/A.	
a. Remove gasket with knife or scribe.		
b. Check new gasket in breastplate for fit.		
1. Not all breastplates are same, require different thicknesses.		
c. If necessary, remove gasket from breastplate and insert in mandrel.	Rough side up.	
d. Put sandpaper around wood block.		
e. Sand gasket evenly.		
f. Check fit.		
g. Clean B/P gasket channel with wire brush.		
3. Practical work.		
a. Each student checks a helmet and breastplate for fit.	Observe and instruct as necessary.	Each student checks at least one helmet and replaces or repairs as necessary.
C. Replace breastplate stud		
1. Failure due to:		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
a. Tightening wing nuts too tight.		
b. Careless handling of helmet and breastplate.		
c. Stripped threads.		
2. Procedures:		
a. Place breastplate in B/P stand.	Demonstrate.	
b. Put wet rags around the area of stud to be removed.	Used to reduce area of heat conduction.	
c. Heat area of stud with torch until solder is melted.	Apply direct heat to stud. Explain heat conduction-- Process by which energy (heat) is transferred from molecule to molecule.	
d. Remove stud and wire brush old solder by adding more heat.		
e. Install new stud.	Wire brush before installing.	
f. Heat area add flux and solder.	Not acid core solder.	
g. Use B/P strap to check for alignment.		
h. Chase B/P stud threads with 1/2 " die.	Use T/A show students how to check alignment.	
3. Practical work.		

1892

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
a. Each student replaces a breastplate stud.	Observe and instruct as necessary.	Replace B/P stud.
D. Replace breastplate padeye.		
1. Failure due to:		
a. Heavy strain on padeye.	Use T/A and demonstrate heavy strain.	
b. Dropped breastplate.		
2. Procedure:		
a. Remove solder from backing plate and breastplate.		
b. File off peeped over stud and remove backing plate.		
c. Clean padeye, backing plate and breastplate.		
d. Insert padeye.		
e. Place backing plate over stud and peen over.		
f. Solder backing plate and stud to breastplate.		
g. Solder padeye to breastplate.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
h. Explain heat conduction.		
3. Practical work.		
a. Only if equipment is available.		
E. Replace telephone transceiver and jack.	Use T/A.	Take notes as necessary.
1. Failure due to:		
a. Water or moisture in transceiver.		
b. Broken wire.		
c. Inoperative speaker.		
2. Procedure:		
a. Disconnect wires inside helmet.		
b. Remove (2) bracket nuts.		
c. Lift out transceiver.		
d. Remove (2) holding screws from gooseneck jack.	Use jack plug element and transceiver for T/A pass around to class.	
e. Heat and remove beeswax.		
f. Remove jack from gooseneck.		
g. Clean gooseneck.		
h. Replacing solder 12" lead from transceiver to new jack element.		

i. Replace two screws in element.

j. Use voltimeter for checking continuity.

k. Melt new beeswax for sealing. Wax to be poured from inside the helmet.

l. Replace jack cover.

m. Replace transceiver in recess over studs.

n. Replace (2) holding nuts on studs then tighten.

3. Practical work.

a. If equipment needing repair is available and time permits, assist students in completing task. Use procedures outlined above.

F. Replacing air or telephone gooseneck. Take notes as necessary.

1. Failure due to:

a. Heavy strain on gooseneck. Show T/A with heavy strain.

b. Stripped threads on gooseneck.

c. Careless handling of helmet. Show cross threading gooseneck threads.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. Procedures:		
a. File off rivet heads.	Use T/A to demonstrate or explain.	
b. Melt solder from backing plate and helmet.		
c. Melt solder from gooseneck and helmet.		
d. Replace gooseneck and backing plate.		
e. Insert rivets and peen over.	On Air Gooseneck, check heat effects on air channels inside.	
f. Solder backing plate to helmet.		
g. Solder around gooseneck and helmet.		
3. Practical work.		
a. If equipment needing repair is available and time permits, assist students in completing task. Use procedures outlined above.		
G. Replace safety locking device.		Observe and take notes as necessary.
1. Failure due to:		
a. Careless installation or removing hat from breastplate.	Use T/A to show.	

1898

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY F STUDENT ACTIVITY
2. Procedures:	
a. Drive out dowel pin.	Use T/A to explain procedures.
b. Melt solder from backing plate.	
c. Melt solder from helmet and latch dome.	
d. File down peened over stud.	
e. Drive out stud and latch base.	
f. Clean area around hole for latch base.	
g. Insert new latch base.	
h. Place backing plate over latch base stud.	
i. Peen over latch base stud.	
j. Solder over stud and backing plate.	
k. Solder around latch base and helmet shell.	
l. Place new dumbbell in latch base.	Caution.
m. Insert dowel pin and peen over.	Care must be taken not to pinch dumbbell base when peening over dowel pin.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
3. Practical work.		
a. If equipment needing repair is available and time permits, assist students in completing task.		
II. Replacing supplementary exhaust valve. (Spit cock)	Use T/A to show.	Observe and take notes as necessary.
1. Failure due to:		
a. Diver hitting it sharply on bottom.		
b. Carelessness in handling helmet.		
2. Procedures:	Use T/A to explain procedures.	
a. Melt solder from retaining ring.		
b. Unscrew retaining ring with 1" open end wrench.	Use only 1" open end wrenct to avoid damage to bonnet.	
c. Melt solder from valve and helmet shell.		
d. Insure area to be soldered is clean.		
e. Insert new valve and screw down retaining ring.		
f. Solder retaining ring and helmet shell.		

1901

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
g. Solder valve base to helmet shell.		
3. Practical work.		
a. If equipment needing repair is available and time permits, assist students in completing task.		
I. Lap in, and adjusting the Air Regulating Exhaust Valve.	Use T/A to show.	Observe and take notes as necessary.
1. Failure due to:		
a. Unskilled personnel lapping in and adjusting the valve.		
b. Dirt and debris caught between the disc and seat.		
c. Weakening of the primary and secondary exhaust valve spring.		
2. Procedures:		
a. Remove screws from valve bonnet guard.	Use T/A to explain and demonstrate.	
b. Unscrew valve bonnet and body. Use 1" open end wrench so as not to		

1993

1622

damage bonnet.

c. Unscrew chin button from valve stem and disc.

d. Use bright work polish to clean parts and lap valve disc to valve seat.

e. Replace springs if necessary.

f. Loosen stem adjusting sleeve to approximately 3/16" then tighten screw.

g. Replace stem through stem guide and screw on chin button.

h. Insure secondary spring is in place and screw valve body and bonnet to helmet.

i. Replace screws in valve bonnet guard.

j. Check valve setting by cracking valve 1/4 turn open tap chin button

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
to insure it started to open.		
k. If valve has not started to open, the valve must be disassembled and the stem sleeve readjusted.		
3. Practical work.		
a. Each student will lap in, adjust, reassemble and check an exhaust valve.	Instruct and advise as necessary.	Each student will perform.
J. Replace faceplate and gasket.		
1. Failure due to:	Use T/A or actual equipment to show.	Observe and take notes as necessary.
a. Worn countersunk recess in faceplate.		
b. Broken lugs on faceplate.		
c. Worn or broken rubber gasket.		
2. Procedures:		
a. Remove cotter pin from hinge pin.		
b. Remove hinge pin from lugs.		
c. Remove old faceplate and replace with new one.		

1996

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1621

d. Replace hinge pin.

e. Replace cotter pin through ninge pin then brad over.

f. If new gasket is necessary, it is easily removed from faceplate with knife. Clean area and replace with new rubber gasket.

3. Practical work.

a. If equipment needing repair is available and time permits, assist students in completing task.

K. Renewing breastplate lanyards. Pass a worn lanyard through class. Observe and take notes as necessary.

1. Failure due to:

a. Age.

b. Excessive use, wear.

2. Procedures:

a. Cut a piece of signal halyard approximately 48-54 inches long.

b. Serve each end approximately 1

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
inch with sail twine.		
c. Insert new line in breastplate eyelets.		
3. Practical work.		
a. Each student will renew and replace a lanyard.	Observe and instruct as necessary.	Each student will renew and replace a lanyard.
III. Summary		
A. Assign practical work dependent upon time and equipment availability.		
B. Answer questions.		Ask questions as necessary.

1910

1911

1626

NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022

Security Clearance: Unclassified

Lesson Topic: 11.2 Mk V Deep Sea Diving System Dress

7 Hours

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual, Vol. I
Student Guides
Standard Classroom Equipment
Mk V Deep Sea Diving System Dress
#4 Goodrich Glue
D/C Plug 5 3/4" to 3 1/2"
Roller
Trichloretholyne
Wire brush
Scissors
L/S Diving Gloves
Patch Templates
#2B Grommets
#2B Grommet Die
Lacing Flap Template (Mk V)
3/8" Gasket Punch
Breastplate Stand
Patching Material
Crotch Patch Template (Mk V)
Sail Twine and Needle
Sewing Palm
Stud Shim
Neets Foot Oil
Screw Driver
Mk V Deep Sea Diving System Weight Belt
Mk V Deep Sea Diving System Shoes

TERMINAL OBJECTIVE

1. When the student completes this course he will be able to, given a Mk V Deep Sea Diving System Dress, perform the following maintenance so that the equipment may be used in diving operations: Placing/replacing gloves, patching a hole, air test dress before/after patching. Additional maintenance items are to be accomplished dependent upon time and equipment requirements.
   a. Replacing lacing flap.
   b. Replacing crotch flap.
   c. Repair and patch torn rubber gasket on collar.
   d. Renew lead weights on Mk V Deep Sea Diving System Weight Belt.
   e. Renew straps and buckles on Mk V Deep Sea Diving System Shoes.
   f. Clean and preserve Mk V Deep Sea Diving System Shoes.

ENABLING OBJECTIVES

1. For each of the repairs/maintenance requirements listed above:
   a. Orally STATE the common cause(s) of the equipment damage/failure/leak which would lead to repairing or replacing the specific piece of equipment.
   b. LIST, in writing, the tools needed for the specific repair.
   c. EXPLAIN, in writing, step-by-step procedures for effecting the repair or replacement.

ENABLING OBJECTIVES (cont'd)

d. Orally EXPLAIN the importance of doing proper maintenance to include results if repair procedures are not carried out properly.

CRITERION TEST

1. Given a Mk V Deep Sea Diving System Dress, perform the following maintenance so that the equipment may be used in diving operations: Placing/replacing gloves, patching a hole, air test dress before/after patching.

HOMEWORK

Student Guide, Volume F,
Assignment Sheets 11-2-1A
and 11-2-2A.

1913

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
II. Presentation		
A. Air testing dress before patching.	Use actual equipment to demonstrate.	Take notes as necessary.
1. Failure due to:		
a. Non Applicable.		
2. Procedures:		
a. Place dress on breastplate stand as you would on a diver.		
b. Open air valve and blow up dress.		
(1) Do not exceed 2 psig pressure.		
c. Locate leak and chalk.	If necessary, use soap and water.	
d. Secure air and remove dress.		
3. Practical work.		Each student will air test a dress for leaks.
a. Each student will air test a dress for leaks.		
B. Placing or replacing a glove on D/S Diving Dress.	Use T/A or actual equipment to show.	Take notes as necessary.
1. Failure due to:		
a. All D/S dresses come from		

1914

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OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY STUDENT ACTIVITY

manufacturer with cuffs.

b. Glove damage due to continuous underwater use.

c. A blow up could blow a glove.

2. Procedures:

a. Dry minimum of 24 hours.

Use T/A to explain. Take notes as necessary.

b. Insert D/C plug from inside of sleeve approximately 4" extending from sleeve.

c. Gloves will be trimmed (cut from gauntlet) according to size of dress being patched.

(1) 3" off of #1 dress.

(2) 2" off of #2 dress.

(3) 1" off of 3# dress.

d. Place glove on D/C plug, rolling it back two inches at the top.

e. Insure the glove is flush with sleeve and that glove and sleeve

1916

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seams are aligned.

f. Clean area with trichloretholyne.

g. Roughen area with wire brush.

h. Apply 3 coats of #4 Goodrich to glove and sleeve allowing each coat to become tacky before applying the next coat.

i. After the third coat is applied, roll the part of the glove turned down, up over the sleeve.

j. Roll vigorously with the roller working from the center.

k. Turn sleeve inside out.

l. Using template cut curved strip from patching cloth.

m. Strip protective cloth from patch and lay on a flat board.

n. Roughen area for applying patch.

o. Apply 3 coats of glue to curved

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
strip and area meeting at sleeve and glove.		
(1) Allow each coat to become tacky before applying the next coat.		
p. Apply curved strip evenly over joint between glove and sleeve.		
q. Turn sleeve right side out and follow the same procedures.		
3. Practical work.		
a. Each student should accomplish these procedures.	Observe and assist as necessary.	Accomplish procedures to place/replace gloves.
C. Patching hole in D/S Diving Dress		Take notes as necessary.
1. Failure due to:	Use T/A to show.	
a. Excessive wear.		
b. Improper stowage.		
2. Procedures:		
a. Dry for minimum of 24 hours.	Use T/A to explain/ demonstrate procedures.	Take notes as necessary.
b. After finding hole, trim loose threads.		

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OUTLINE OF INSTRUCTION INSTRUCTOR ACTIVITY STUDENT ACTIVITY

c. Cut patch 1" larger than hole to be patched.

(1) Round all corners.

d. Strip protective cloth and lay on flat board.

e. Roughen area to be patched.

f. Apply 3 coats of glue allowing each coat to become tacky before applying the next.

g. When ready, lay patch evenly over hole and press firmly.

h. Use roller and working from center outward roll out all bubbles.

i. Any edge of patch that does not adhere, trim off.

(1) Do not try to re-glue.

j. Allow 24 hours to dry before testing and using.

3. Practical work.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
a. Each student should perform procedures.	Observe and instruct as necessary.	Each student patches a hole in D/S Diving Dress.
D. Replacing lacing flap on D/S Diving Dress	Use T/A to show.	Take notes as necessary.
1. Failure due to:		
a. Excessive use of the dress.		
b. Over tightening of the laces.		
2. Procedures:		
a. Dry for minimum of 24 hours.	Use T/A to explain or demonstrate procedures.	Take notes as necessary.
b. Using lacing flat template, cut two lacing flaps from patching material.		
c. To remove old flap, pull around end patch from lacing flap.		
d. Bench mark with chalk both ends of lacing flat to insure proper alignment of new lacing flap.		
e. Pull off old lacing flap.		
f. Take the two new lacing flaps,		

1922

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strip protective cloth and lay on flat board.

g. Apply three coats of #4 Goodrich and glue flap pieces together. Leave 3/4" unglued along straight edge.

h. Allow ample time for glue to set up before punching holes for grommets.

i. After punching holes for grommets install #2B grommet using grommet die.

j. Clean area for lacing flap on dress with trichloretholyne.

k. Use wire brush to roughen area.

(1) Be sure not to remove chalk mark. Emphasize.

l. Apply 3 coats of #4 Goodrich glue

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
to area for lacing flap on dress and on new lacing flap.		
(1) The unglued 3/4" area is butterflied to make 1 1/2" surface which is the part glued to dress.	Draw lacing flap to show butterfly or show actual equipment	
m. After glue is applied, place lacing flap on dress using chalk mark for alignment.		
n. Use roller to roll out air bubbles.		
o. Cut lacing flap end patch	Draw end patch on C/B or show actual equipment	
p. Remove protective cloth and lay on flat board.		
q. Clean area to be patched on dress with Trichloretholyne, then wire brush.		
r. Apply 3 coats of #4 Goodrich glue to patch and dress.		
s. Place end patch on dress and roll out bubbles.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
t. Allow 24 hours to dry before testing use.		
3. Practical Work		
a. If equipment needing repair is available and time permits, student should complete task.	Observe and instruct as necessary	Each student replace lacing flap on D/S Diving Dress
E. Replacing Crotch Patch		
1. Failure due to:		
a. Repeated use of D/S Diving Dress	Use equipment, picture or chart to show	
2. Procedures		
a. Dry for a minimum of 24 hours		
b. Place D/S diving dress on breastplate stand and apply 1/2 lb of air.		
c. Remove old crotch patch		
d. Clean area with Trichloretholyne.		
e. Roughen area with wire brush.		
f. Using crotch patch template and patching material, cut out new patch.		
g. Remove protective cloth and lay on flat board.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
h. Apply 3 coats of #4 Goodrich glue to patch and dress.		
i. Place patch on crotch area of dress and roll out bubbles.		
j. Secure air and remove dress from breastplate stand.		
k. Allow 24 hours before testing and using.		
3. Practical Work		
a. If equipment needing repair is available and time permits, each student should replace crotch patch.	Observe and instruct as necessary.	Each student replaces crotch patch on D/S diving dress.
F. Repair Torn Rubber Gasket on Collar	Use actual equipment, chart or transparency	
1. Failure Due to:		
a. Repeated use of dress		
b. Diver using smaller dress than necessary.		
c. Careless removal of breastplate.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
2. Procedures		
a. Dry for a minimum of 24 hours.		
b. Glue torn area of collar together.		
c. Sew torn area using herring bone stitch.	Demonstrate	
3. Practical Work		
a. If equipment needing repair is available and time permits, assist student in completing task.	Observe and instruct as necessary.	Each student repairs torn rubber gasket on collar.
G. Clean and Preserve D/S Diving Shoes	Use actual equipment to show	
1. Failure due to:		
a. Repeated use in water.		
b. Improper use of Neets Foot Oil on shoe.		
2. Procedures		
a. Wire brush leather lightly to remove dirt and soiled oil.		
b. Inspect		
c. Coat Lightly with Neets Foot Oil.		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
3. Practical Work		
a. If equipment needing repair is available and time permits, assist students in completing task.	Observe and instruct as necessary	Clean Diving Shoes
VII. Summary		
A. Assign Practical Work dependent upon time and equipment requirements.		
B. Answer questions		Ask questions as necessary

1932

1933

1940

NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022

Security Clearance: Unclassified

Lesson Topic: 11.3 Mk V Deep Sea Diving System Umbilical

5 Hours

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual, Vol. I
Lifeline and Air Hose (Mk V)
Standard Classroom Equipment
Student Guides
150 psi air supply
Marline
Knife
Air Control Valve
#6 Canvas
Sail Needle
Sewing Palm
Sail Twine
Paint
1/8" Line, white

TERMINAL OBJECTIVE

1. When the student completes this course he will be able to, given components of the Mk V Deep Sea Diving System Umbilical, perform the following maintenance so that the equipment may be used in diving operations: Marry lifeline/air hose, and repair or replace jack plug on lifeline, telephone cable. Additional maintenance

TERMINAL OBJECTIVE (cont'd)
items are to be a
items are to be accomplished dependent upon time and equipment requirements.

ENABLING OBJECTIVES

1. For each of the repairs/maintenance requirements listed above:
   a. Orally STATE the common cause(s) of the equipment damage/failure/leak which would lead to repairing or replacing the specific piece of equipment.
   b. LIST, in writing, the tools needed for the specific repair.
   c. EXPLAIN, in writing, step-by-step procedures for effecting the repair or replacement.
   d. Orally EXPLAIN the importance of doing proper maintenance to include results if repair procedures are not carried out properly.

CRITERION TEST

1. Given components of the Mk V Deep Sea Diving System Umbilical, perform the following maintenance so that the equipment may be used in diving operations: Marry lifeline/air hose, and repair or replace jack plug on lifeline, telephone cable.

HOMEWORK

Student Guide, Volume K, Assignment Sheets 11-3-1A and 11-3-2A.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
II. Presentation		
A. Marrying Lifeline and Air Hose	Use actual equipment or T/A	Observe. Take notes as necessary
1. Failure due to:		
a. Repeated use of the lifeline and air hose.		
b. Outdated hose in use.		
c. Hose cannot meet required tests.		
2. Procedures	Use T/A or actual equipment to demonstrate.	Observe
a. Secure lifeline to an available stancion or similar item.		
b. Take up slack and secure other end so that lifeline is 4 ft. off deck.		
c. Connect one end of hose to air manifold.		
d. Put Air Control Valve at other end and pressurize to 150 psi.		
e. Chalk mark 31 inches back of jack plug on lifeline.		
f. Start air hose fitting at chalk mark on lifeline.		

1936

1937

1642

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

g. Measure back 22 inches from first chalk mark and make first marriage.

(1) Marry together using eight turns of marline and two inner turns between lifeline and air hose, then tie with square knot.

h. Repeat marriages every 4 ft. with a 4 inch catenary in air hose.

(1) Lightweight hose is married every 3 ft.

i. The amount unmarried for topside hook up is determined by the distance between air manifold and communication jack on diving station.

j. The length of making up a lifeline and air hose is determined by the ship or diving command.

3. Practical Work

a. Each student performs procedures. May use shortened piece of hose.	Observe and instruct as necessary.	Each student will make up lifeline/air hose.

1938

1939

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
B. Placing/Replacing Boot		
1. Failure due to:	Use actual equipment or T/A	Observe. Take notes as necessary.
a. Repeated use of lifeline/air hose.		
b. Making up new lifeline/air hose.		
2. Procedures		
a. Cut a strip of #6 canvas 13" wide and 47' long.		
b. Fold canvas so that both sides meet at center.	Demonstrate with piece of paper.	
c. Start boot at first permanent marriage on lifeline/air hose.		
d. Fold boot around lifeline/air hose.		
e. Using needle and sail twine, sew canvas tight using herring bone stitch.		
f. Use 1/8" line, put a turks head at each end of canvas.		
g. Soak canvas in water to tighten.		
h. Paint canvas the desired color code, before it completely dries.		

1940

1941

1944

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
3. Practical Work		
a. If equipment needing repair is available and time permits, assist students in completing task.	Observe and instruct as necessary.	Complete procedures for making boot for umbilical.
C. Replace/Repair Jack Plug		
1. Failure due to:		
a. Improper handling		
b. Improper storage		
c. Usage		
2. Procedures	Use actual equipment or T/A to explain/ demonstrate procedures.	Observe. Take notes as necessary.
a. Unscrew gland nut at rear of plug housing.		
b. Remove packing.		
c. Remove lock nut at front of plug housing with spanner wrench.		
d. Heat plug housing to soften the sealing compound.		
e. Slide plug housing back on cable away from cable.		

1942

1943

1645

f. Loosen connections to plug terminals and remove plug.

g. Melt solder which secures stainless steel core in the anchor plug, and remove the wood screw wedge and anchor plug.

h. The cable may be cut back to the damaged end and communications tested.

i. Reassembly:

(1) Slide gland nut and jack plug housing onto cable.

(2) Remove the two outer rubber coverings for a distance of about 4 inches; remove the rubber covering of the stainless steel core also for 4 inches.

(3) Separate the exposed strands, clean and tin thoroughly.

(4) Slip anchor plug over the tin strands and core, then bring up as close as possible to the rubber covering.

(5) Distribute strands and core around circumference of hole in plug and drive in wood screw wedge.

(6) Solder the steel core and wedge securely into anchor plug.

(7) Cut off loose ends of steel core even with anchor plug and smooth with a file.

(8) Bare ends of the conductors and twist together into two pairs, red with green and black with white.

(9) Form an eye in the end of each pair and solder.

(10) Pull plug housing down over

anchor, plug as far as possible. Length of conductor should be about 1/4 inch out of plug housing.

(11) Several turns of flax packing should be inserted into the gland and gland nut screwed in tight.

(12) Place thin leather washer over conductors and attach conductors to plug terminals making sure that red/green pair is connected to the side terminal and black/white to the center terminal.

(13) Pour melted sealing compound or beeswax into open end of housing to within 1/4 " of plug seat.

(14) While sealing compound is still soft, seat the jack plug in plug housing, making certain that the leather washer is properly seated.

1916

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(15) Screw in locking nut and pull up tight.		
3. Practical Work		
a. Each student should perform procedures.	Observe and instruct as necessary.	Student repair/replace jack plug.
III. Summary		
A. Assign practical work dependent upon time and equipment availability.		
B. Answer questions		Ask questions as necessary.

NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022

Security Clearance: Unclassified

Lesson Topic: 11.5 Mk V Deep Sea Diving System Air Control Valve

5 1/2 Hours

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual, Vol. I
Student Guides
Standard Classroom Equipment
Screw Driver
Flax Packing
Adjustable Wrench
Bright Work Polish
Clean Rag
Scribe

TERMINAL OBJECTIVE

1. When the student completes this course he will be able to, given a Mk V Deep Sea Diving System Air Control Valve, perform the following maintenance so that the equipment may be used in diving operations: Lap in needle valve, renew flax packing in packing gland and adjust packing gland.

ENABLING OBJECTIVES

1. For each of the repairs/maintenance requirements listed above:

ENABLING OBJECTIVES (cont'd)

   a. Orally STATE the common cause(s) of the equipment damage/failure/leak which would lead to repair/replacement of the specific piece of equipment.
   b. LIST, in writing, the tools needed for the specific repair.
   c. EXPLAIN, in writing, step-by-step procedures for effecting the repair or replacement.
   d. Orally EXPLAIN the importance of doing proper maintenance-to include results if procedures are not carried out properly.

CRITERION TEST

1. Given a Mk V Deep Sea Diving System Air Control Valve, perform the following maintenance so that the equipment may be used in diving operations: Lap in needle valve, renew flax packing in packing gland and adjust packing gland.

HOMEWORK

Student Guide, Volume K
Assignment Sheets

1959

1949

1950

1951

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
II. Presentation		
A. Lap in Needle Valve, Renew Flax Packing, and Adjust Packing Gland in Air Control Valve	Use actual equipment or T/A to explain/ demonstrate procedures	Observe. Take notes as necessary
1. Failure due to:		
a. Repeated use		
2. Procedures	Demonstrate	
a. Remove valve wheel and bracket.		
b. Remove capnut and stuffing box gland.		
c. Use scribe to remove lead washer and flax packing.		
d. Use wrench to remove stuffing box.		
e. Remove copper washer and valve stem.		
f. Inspect disc (60° angle) and seat.		
g. If needed, lap in disc and seat with bright work polish.		
h. Clean disc and seat with clean rag before reassembling.		

1951

1952

i. Screw valve stem into the stuffing box.

j. Place copper ring into the groove on top of valve body.

k. Insert valve stem into body and tighten stuffing box wrench tight.

l. Insert first lead washer over valve stem.

m. Add new flax packing rings staggering the batts.

n. Insert second lead washer.

o. Insert the stuffing box gland and screw capnut into position.

p. Adjust so that valve will not turn easily.

q. Replace screws in bracket.

r. Replace valve wheel.

s. Replace locking nut.

t. Replace cotter key through locking nut.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
3. Practical Work		
a. Each student performs procedures.	Observe and instruct as necessary.	Repair Air Control Valve
B. Planned Maintenance System (PMS) Requirements for the Mk V Deep Sea Diving System	Use PMS cards, or T/A to show.	
	Use most current PMS requirements	
III. Summary		
A. Assign practical work dependent upon time and equipment availability.		
B. Answer questions		Ask questions as necessary.

1953

1954

1955

NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022

Security Clearance: Unclassified

Lesson Topic: 12.1 Hyperbaric Chamber Operations

30 Hours

INSTRUCTIONAL MATERIAL

U.S. Navy Diving Manual, Vol. I
Student Guide
Standard Classroom Equipment
Hyperbaric Chamber

TERMINAL OBJECTIVES

1. When the student completes this course he will be able to, given a diving accident requiring treatment in the Hyperbaric Chamber, perform the functions of an outside Hyperbaric Chamber Operator under the guidance of a diving supervisor.

ENABLING OBJECTIVES

1. Given a standard print of a Hyperbaric System:
   a. EXPLAIN the function (s) of the major components in terms of what they do for the system.

ENABLING OBJECTIVES (cont'd)

   b. DESCRIBE/ show the functional and physical location of the major components and their component parts.
   c. DESCRIBE, in writing, the sources of power for the supply piping arrangement and communication components.
   d. Orally DESCRIBE the modes of control.
   e. LIST, in writing, the protective devices for the major components.
   f. LIST, orally, the ratings of the major components.
   g. DESCRIBE, in writing, the nominal pipe or valve size used throughout the Hyperbaric Chamber System.
   h. LIST, in writing, the major materials used in the major components and their component parts, and EXPLAIN why.
   i. Orally EXPLAIN how the components and component parts carry out their function(s).
   j. DESCRIBE, in writing, procedures for pressurization and depressurization of the recompression chamber.
   k. DESCRIBE, in writing, the administration of HeO2/O2 to the recompression chamber.
   l. DESCRIBE, in writing, procedures for ventilation of the recompression chamber.

1956

ENABLING OBJECTIVES (cont'd)

m. Orally STATE the setpoint(s) and reasons for the setpoint(s) in terms of operating above/below them for:
(1) The maximum working pressure of the chamber.
(2) Ventilation Rate, O2, air.

n. DESCRIBE, in writing, the effect on this system due to the air and electrical sources.

o. Orally EXPLAIN the safety precautions unique to the Hyperbaric Chamber, to include the following:
(1) Use of fire retardent material inside the chamber.
(2) Release of dogs prior to depressurization of the chamber.

2. Under the guidance of the instructor, DEMONSTRATE procedures for pressurization of the chamber, checking for leaks, and normal operation of gauges.

3. LIST situations common to diving, in writing, where the Hyperbaric Chamber would be required for medical treatment.

CRITERION TEST

1. Given a hypothetical diving accident requiring treatment in the Hyperbaric Chamber, perform the functions of an outside Hyperbaric Chamber Operator under the guidance of a diving supervisor.

HOMEWORK

Student Guide Volume L Information Sheet 12-1-1I Assignment Sheet 12-1-1A through 12-1-4A

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction		
A. Establish Contact	Introduce self and topic	
B. Establish Readiness	Get Students ready to learn Classroom procedures, etc.	
C. Establish Effect	Bring out need and value of material	
D. Overview	State Learning Objectives	
II. Presentation		
A. Decompression Chamber Theory		
1. Many situations may arise during or after diving operations that require the use of a recompression facility.	May quiz students	Take notes as necessary
a. Treatment of diver's diseases or injuries.		
(1) Decompression Sickness		
(2) Gas Embolism		
(3) CO2 and CO Toxicity		
b. Surface Decompression Procedures		
(1) Surface Decompression using Oxygen.		

1958

1959

1656

(2) Surface Decompression using air.

(3) Helium-Oxygen Surface Decompression.

c. Equipment Testing and Checkout

(1) Wrist Depth Gauges

(2) Diving Watches for watertight integrity.

(3) Lifeboat hydrostatic releases.

d. Hyperbaric Oxygen Therapy for Non-diving injuries

(1) Gas Gangrene

(2) Tetanus

(3) Various conditions producing anoxia (hypoxia).

e. Diving Candidate Selection - Pressure O2 Tolerance Tests

f. Various aspects of Diver Training

(1) Qualification dives

(2) Chamber Training

OUTLINE OF INSTRUCTION INSTRUCTOR ACTIVITY STUDENT ACTIVITY

2. Chamber design types and basic operational requirements

a. Double lock chambers are the most commonly used type in the Navy.

(1) Fabricated from steel or aluminum.

(2) Steel Double Lock Chamber

(a) 200 psi working pressure.

(b) 500 cubic ft total volume.

1. 350 cu ft inner lock volume.

2. 150 cu ft outer lock volume.

(3) Aluminum double lock chamber was designed to replace single lock steel chamber.

(a) 100 psi working pressure.

(b) 227 cu ft total volume.

(4) Double Lock Chambers are versatile.

(a) Possible to treat 2 casualties simultaneously.

(b) Tenders can be changed and

decompressed in outer lock during inner lock treatment.

b. Single Lock Chambers

(1) Very few still in Navy use.

(2) Fabricated from steel.

(a) 100 psi working pressure.

(b) 250 cu ft in volume.

(3) Has basic disadvantage of being unable to change tenders during treatment.

c. All Navy Chambers have similar design requirements.

(1) Medical Lock

(a) About 18" in diameter.

(b) Used to pass small articles in and out during pressurization of main chamber.

(2) All Navy chambers must be capable of pressurization to 165' or

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
73.425 psig as a minimum. (3) Must have a primary and secondary air supply source. (4) Should have oxygen treatment capability. (5) Must be equipped with both a one-way and two-way control systems. (6) Must have communications. (7) Must be equipped with gauges on each lock.		
3. Air Supply System for Chambers a. Design requirements are for a primary and secondary air supply for all Navy chambers. No two air supply systems are <u>exactly</u> alike in meeting basic requirements.		Take notes as necessary.
1983 (1) Primary air supply is commonly a bank of H.P.cylinders capable	Place diagram on C/B of typical air system, use transparency or chart. (See 12a and 12b this Instructor Guide)	1984 1660

NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022

Security Clearance: Unclassified

Lesson Topic: 11.3 Mk V Deep Sea Diving System Umbilical

5 Hours

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual, Vol. I
Lifeline and Air Hose (Mk V)
Standard Classroom Equipment
Student Guides
150 psi air supply
Marline
Knife
Air Control Valve
#6 Canvas
Sail Needle
Sewing Palm
Sail Twine
Paint
1/8" Line, white

TERMINAL OBJECTIVE

1. When the student completes this course he will be able to, given components of the Mk V Deep Sea Diving System Umbilical, perform the following maintenance so that the equipment may be used in diving operations: Marry lifeline/air hose, and repair or replace jack plug on lifeline, telephone cable. Additional maintenance

1965

TERMINAL OBJECTIVE (cont'd)
items are to be a
items are to be accomplished dependent upon time and equipment requirements.

ENABLING OBJECTIVES

1. For each of the repairs/maintenance requirements listed above:
   a. Orally STATE the common cause(s) of the equipment damage/failure/leak which would lead to repairing or replacing the specific piece of equipment.
   b. LIST, in writing, the tools needed for the specific repair.
   c. EXPLAIN, in writing, step-by-step procedures for effecting the repair or replacement.
   d. Orally EXPLAIN the importance of doing proper maintenance to include results if repair procedures are not carried out properly.

CRITERION TEST

1. Given components of the Mk V Deep Sea Diving System Umbilical, perform the following maintenance so that the equipment may be used in diving operations: Marry lifeline/air hose, and repair or replace jack plug on lifeline, telephone cable.

HOMEWORK

Student Guide, Volume K, Assignment Sheets 11-3-1A and 11-3-2A.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
II. Presentation		
A. Marrying Lifeline and Air Hose	Use actual equipment or T/A	Observe. Take notes as necessary
1. Failure due to:		
a. Repeated use of the lifeline and air hose.		
b. Outdated hose in use.		
c. Hose cannot meet required tests.		
2. Procedures	Use T/A or actual equipment to demonstrate.	Observe
a. Secure lifeline to an available stancion or similar item.		
b. Take up slack and secure other end so that lifeline is 4 ft. off deck.		
c. Connect one end of hose to air manifold.		
d. Put Air Control Valve at other end and pressurize to 150 psi.		
e. Chalk mark 31 inches back of jack plug on lifeline.		
f. Start air hose fitting at chalk mark on lifeline.		

1966

1997

1662

g. Measure back 22 inches from first chalk mark and make first marriage.

(1) Marry together using eight turns of marline and two inner turns between lifeline and air hose, then tie with square knot.

h. Repeat marriages every 4 ft. with a 4 inch catenary in air hose.

(1) Lightweight hose is married every 3 ft.

i. The amount unmarried for topside hook up is determined by the distance between air manifold and communication jack on diving station.

j. The length of making up a lifeline and air hose is determined by the ship or diving command.

3. Practical Work

a. Each student performs procedures. May use shortened piece of hose. — Observe and instruct as necessary. — Each student will make up lifeline/air hose.

1968

1969

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
B. Placing/Replacing Boot		
1. Failure due to:	Use actual equipment or T/A	Observe. Take notes as necessary.
a. Repeated use of lifeline/air hose.		
b. Making up new lifeline/air hose.		
2. Procedures		
a. Cut a strip of #6 canvas 13" wide and 47' long.		
b. Fold canvas so that both sides meet at center.	Demonstrate with piece of paper.	
c. Start boot at first permanent marriage on lifeline/air hose.		
d. Fold boot around lifeline/air hose.		
e. Using needle and sail twine, sew canvas tight using herring bone stitch.		
f. Use 1/8" line, put a turks head at each end of canvas.		
g. Soak canvas in water to tighten.		
h. Paint canvas the desired color code, before it completely dries.		

1970

1971 1664

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
3. Practical Work		
a. If equipment needing repair is available and time permits, assist students in completing task.	Observe and instruct as necessary.	Complete procedures for making boot for umbilical.
C. Replace/Repair Jack Plug		
1. Failure due to:		
a. Improper handling		
b. Improper storage		
c. Usage		
2. Procedures	Use actual equipment or T/A to explain/ demonstrate procedures.	Observe.Take notes as necessary.
a. Unscrew gland nut at rear of plug housing.		
b. Remove packing.		
c. Remove lock nut at front of plug housing with spanner wrench.		
d. Heat plug housing to soften the sealing compound.		
e. Slide plug housing back on cable away from cable.		

1972

1973

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

f. Loosen connections to plug terminals and remove plug.

g. Melt solder which secures stainless steel core in the anchor plug, and remove the wood screw wedge and anchor plug.

h. The cable may be cut back to the damaged end and communications tested.

i. Reassembly:

(1) Slide gland nut and jack plug housing onto cable.

(2) Remove the two outer rubber coverings for a distance of about 4 inches; remove the rubber covering of the stainless steel core also for 4 inches.

(3) Separate the exposed strands, clean and tin thoroughly. 1974

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

(4) Slip anchor plug over the tin strands and core, then bring up as close as possible to the rubber covering.

(5) Distribute strands and core around circumference of hole in plug and drive in wood screw wedge.

(6) Solder the steel core and wedge securely into anchor plug.

(7) Cut off loose ends of steel core even with anchor plug and smooth with a file.

(8) Bare ends of the conductors and twist together into two pairs, red with green and black with white.

(9) Form an eye in the end of each pair and solder.

(10) Pull plug housing down over

anchor, plug as far as possible. Length of conductor should be about 1/4 inch out of plug housing.

(11) Several turns of flax packing should be inserted into the gland and gland nut screwed in tight.

(12) Place thin leather washer over conductors and attach conductors to plug terminals making sure that red/green pair is connected to the side terminal and black/white to the center terminal.

(13) Pour melted sealing compound or beeswax into open end of housing to within 1/4 " of plug seat.

(14) While sealing compound is still soft, seat the jack plug in plug housing, making certain that the leather washer is properly seated.

1669

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(15) Screw in locking nut and pull up tight.		
3. Practical Work		
a. Each student should perform procedures.	Observe and instruct as necessary.	Student repair/replace jack plug.
III. Summary		
A. Assign practical work dependent upon time and equipment availability.		
B. Answer questions		Ask questions as necessary.

1977

1978

NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022

Security Clearance: Unclassified

Lesson Topic: 11.4 Mk V Deep Sea Diving System Non-Return Valve

5 1/2 Hours

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual, Vol. I
Student Guides
Standard Classroom Equipment
Mk V Deep Sea Diving System Non-Return Valve
T Wrench
Neets Foot Oil
Scribe

TERMINAL OBJECTIVE

1. When the student completes this course he will be able to, given a Mk V Deep Sea Diving System Non-Return Valve, perform the following maintenance so that the equipment may be used in diving operations: Replace the stem and seat, and replace the spring and gasket.

ENABLING OBJECTIVES

1. For each of the repairs/maintenance requirements listed above:
   a. Orally STATE the common cause(s) of equipment damage/failure/leak which would lead to repair/replacement

1979

ENABLING OBJECTIVES (cont'd)

   of the specific piece of equipment.
   b. LIST, in writing, the tools needed for the specific repair.
   c. EXPLAIN, in writing, step-by-step procedures for effecting the repair or replacement.
   d. Orally EXPLAIN the importance of doing proper maintenance to include results if procedures are not carried out properly.

CRITERION TEST

1. Given a Mk V Deep Sea Diving System Non-Return Valve, perform the following maintenance so that the equipment may be used in diving operations: Replace the stem and seat, and replace the spring and gasket.

HOMEWORK

Student Guides, Volume K
Assignment Sheet 11-4-1A

1980

1979

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
II. Presentation		
A. Replacing Stem, Washer, Spring and Gasket of the Non-Return Valve	Use actual equipment or T/A to demonstrate and explain procedures.	Observe. Take notes as necessary.
1. Failure due to:		
a. Improper upkeep.		
b. Excessive usage and worn parts.		
2. Procedures	Demonstrate	
a. Using scribe, remove leather gasket from Non-Return Valve.		
b. Insert T wrench in slot or upper guide to remove stem assembly.		
c. Inspect disc and spring. Replace if necessary.		
d. Soak all parts, except washer, in vinegar.		
e. Apply Neets Foot Oil to washer.		
f. Wipe dry then reassemble.		
g. NOTE: New type Non-Return Valves need only new cartridge.	Cartridge has arrow to indicate air flow	

1981

1982

1671

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
3. Practical Work		
a. Each student perform procedures.	Observe and instruct as necessary	Each student repair a Non-Return Valve.
III. Summary		
A. Assign practical work dependent upon time and equipment requirements.		
B. Answer questions		Ask questions as necessary.

1993

1994

1672

1673

NAVAL SCHOOL DIVING AND SALVAGE

Diver, Second Class A-433-0022

Security Clearance: Unclassified

Lesson Topic: 11.4 Mk V Deep Sea Diving System Non-Return Valve

5 1/2 Hours

INSTRUCTIONAL MATERIALS:

U.S. Navy Diving Manual, Vol. I
Student Guides
Standard Classroom Equipment
Mk V Deep Sea Diving System Non-Return Valve
T Wrench
Neets Foot Oil
Scribe

TERMINAL OBJECTIVE

1. When the student completes this course he will be able to, given a Mk V Deep Sea Diving System Non-Return Valve, perform the following maintenance so that the equipment may be used in diving operations: Replace the stem and seat, and replace the spring and gasket.

ENABLING OBJECTIVES

1. For each of the repairs/maintenance requirements listed above:
   a. Orally STATE the common cause(s) of equipment damage/failure/leak which would lead to repair/replacement

1995

ENABLING OBJECTIVES (cont'd)

   of the specific piece of equipment.
   b. LIST, in writing, the tools needed for the specific repair.
   c. EXPLAIN, in writing, step-by-step procedures for effecting the repair or replacement.
   d. Orally EXPLAIN the importance of doing proper maintenance to include results if procedures are not carried out properly.

CRITERION TEST

1. Given a Mk V Deep Sea Diving System Non-Return Valve, perform the following maintenance so that the equipment may be used in diving operations: Replace the stem and seat, and replace the spring and gasket.

HOMEWORK

Student Guides, Volume K
Assignment Sheet 11-4-1A

1996

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
II. Presentation		
A. Replacing Stem, Washer, Spring and Gasket of the Non-Return Valve	Use actual equipment or T/A to demonstrate and explain procedures.	Observe. Take notes as necessary.
1. Failure due to:		
a. Improper upkeep.		
b. Excessive usage and worn parts.		
2. Procedures	Demonstrate	
a. Using scribe, remove leather gasket from Non-Return Valve.		
b. Insert T wrench in slot or upper guide to remove stem assembly.		
c. Inspect disc and spring. Replace if necessary.		
d. Soak all parts, except washer, in vinegar.		
e. Apply Neets Foot Oil to washer.		
f. Wipe dry then reassemble.		
g. NOTE: New type Non-Return Valves need only new cartridge.	Cartridge has arrow to indicate air flow	

1997

1998

1674

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
3. Practical Work		
a. Each student perform procedures.	Observe and instruct as necessary	Each student repair a Non-Return Valve.
III. Summary		
A. Assign practical work dependent upon time and equipment requirements.		
B. Answer questions		Ask questions as necessary.

1989

1990

of pressurization up to 3000 psig.

(a) Volume of cylinders varies, but they range from 7-12 cu ft internal volume.

(b) Should contain enough air to pressurize the chamber to design pressure twice.

(2) The secondary (or reserve) air supply is commonly a H.P.compressor.

(a) Should be able to take the chamber to its working pressure at a rate of at least 50 fpm.

(b) Usually connected to the chamber through a volume tank or reducer.

1. Both reduce the high pressure produced to usable limits.

2. Volume tank can act as an emergency reserve.

1991

3. Cools the pressurized air.

(c) Also used to charge the primary air banks to 3000 psi.

b. Air Supply Lines (H.P. and L.P.) must be painted black.

c. Exhaust lines must be painted silver or aluminum.

d. Air quality must meet current standards established by BUMED.

(1) Oxygen 20-22% by volume — Place on C/B, use transparency or chart.

(2) Carbon Dioxide (CO2) 0.03 - 0.05% by volume or 300-500 parts per million.

(3) Carbon Monoxide 0.002% by volume or 20 parts per million.

(4) Oil, mist, vapor 5 milligrams per milliliter maximum.

(5) Odor not objectionable.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
e. Chamber must be equipped with H.P. safety valves set at the proper pressure for the chamber.		
4. Chamber Piping System		
a. Supply Piping System is referred to as H.P. from the flasks or compressor to the pressure regulator, and L.P. from the regulator to the chamber.	Place on C/B, use transparency or chart (See 12a and 12b this Instructor Guide)	
(1) High pressure piping		
(a) usually made of 1/2" or 3/4" thick wall steel pipe.		
(b) must be tested to 4500 psi (1 1/2 times 3000 psi working pressure).		
(2) The pressure regulator is a device that reduces H.P. air to L.P. air.		
(a) Reduces 3000psi to 0-600 psi.		

(b) Generally the weakest point in the system and must be equipped with a bypass in case of failure.

(c) Manufactured by various companies according to NAVFAC specifications.

Show on drawing of air supply system (See 12a and 12b this Instructor Guide)

(3) Low Pressure Piping

(a) Fabricated from 1 1/2" thick wall steel, bronze or copper pipe.

(b) Must be tested to 900 psi (1 1/2 times 600 psi working pressure).

b. Exhaust Piping System is commonly made of 2 1/2" or 3" galvanized steel, bronze or copper.

c. Oxygen and Helium Oxygen Piping

(1) Both are H.P. piping, usually 1/2" I.D.

(2) Regulators are most commonly the "hospital" type available from federal stock.

1994

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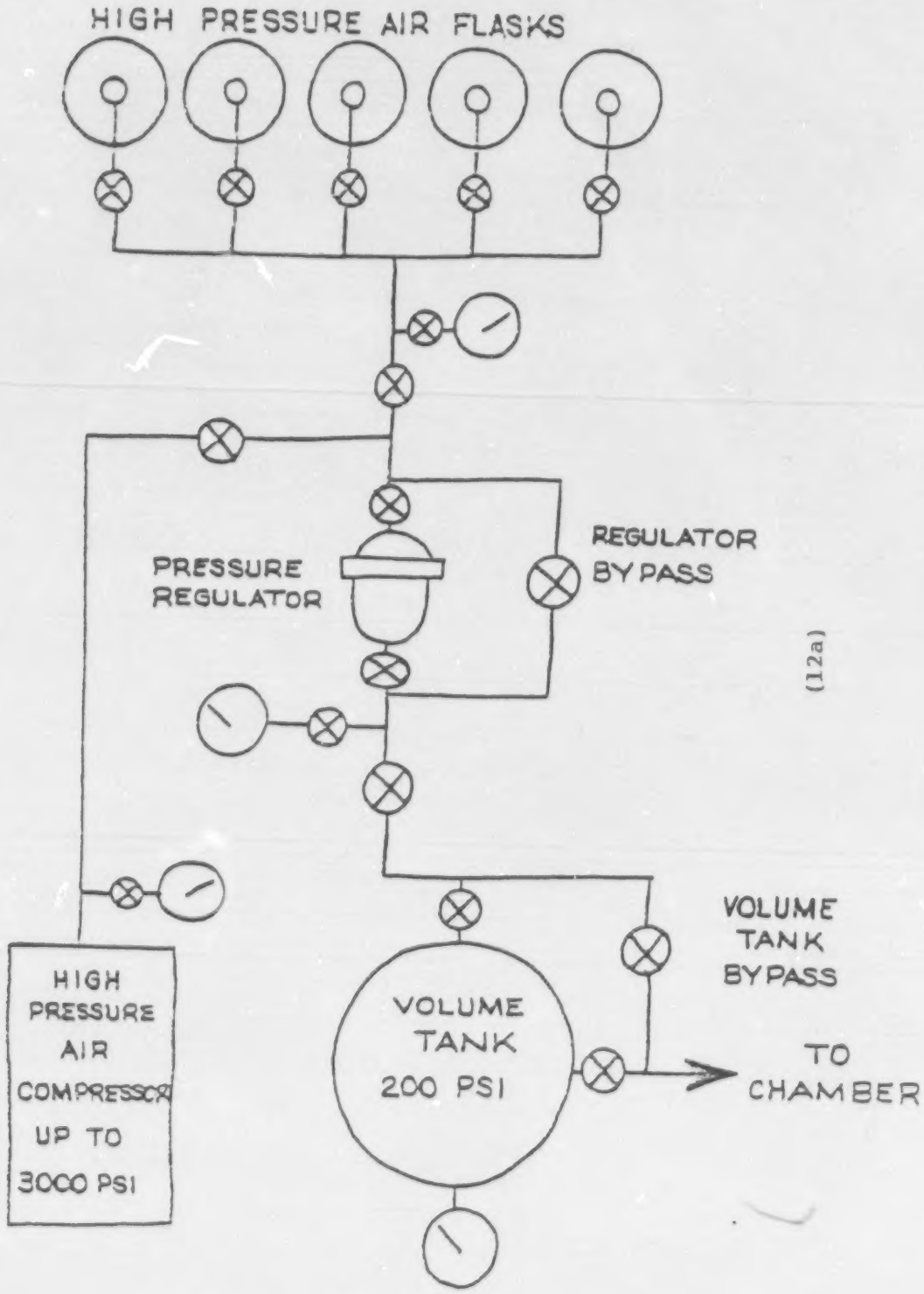
OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(3) Manifold inside the chamber splits gas into demand masks.		
d. Control Valve	Show on drawing of air supply system (See 12a and 12b this Instructor Guide)	
(1) Valves for both supply and exhaust.		
(2) Located wherever needed in the system to direct air flow.		
e. Color Coding of piping and valves.		
(1) Air (H.P. or L.P.) Supply - Black		
(2) Exhaust - Silver or aluminum		
(3) Oxygen Supply - green		
(4) Helium-Oxygen - Orange		
5. Electrical, Lighting, and Communication Systems		
a. All internal chamber wiring must meet strict design and installation requirements.		
(1) Must be heavy duty type, either armored cable or in conduit.		

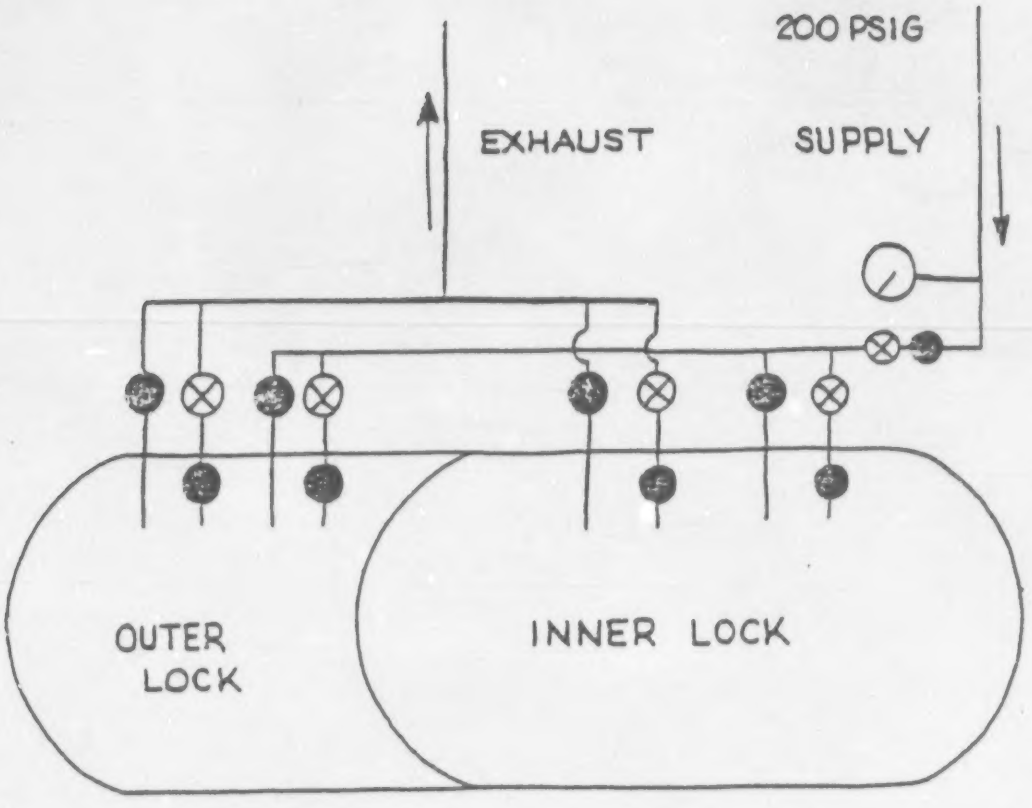
1681



(12a)

1997

1682



(12b)

ONE-WAY CONTROL SYSTEM - VALVES OUTSIDE
TWO-WAY CONTROL SYSTEM - VALVES INSIDE & OUTSIDE

● - CLOSED VALVE
⊗ - OPEN VALVE

RECOMPRESSION CHAMBER OPERATION

1998

(2) All switches and outlets for chamber must be located outside the chamber.

(3) No appliances or service mechanisms that are electrically powered inside the chamber.

b. Chamber illumination is best accomplished by exterior lights.

(1) Older chambers may have interior lighting that meet these requirements:

(a) pressureproof

(b) permanently installed

(c) not flourescent

(d) maximum 40 watt bulbs — Explain heat build-up with higher wattage

(2) Portable exterior lights now available.

c. Chamber Communications

(1) Primary System

(a) Diver's Reproducer in each lock - same as Mk V.

(b)Diving amplifier, guided radio or Helle models, located outside.

(2) Secondary Communications

(a) Leather/rawhide or lead mallet.

(b) Standard Diver's Hand Signals.

6. Helium-Oxygen and Oxygen Supply

a. Gas is kept in standard 200 cu ft gas bottles.

(1) At least two bottles per bank.

(2) At least two banks of each gas.

b. Banks located close to the chamber.

c. Bank pressure checked prior to commencing diving operations. Explain why pressure is checked prior to normal diving.

d. Piping is high pressure as previously explained.

e. Gas to the diver is controlled from outside the chamber with regulators.

f. Demand regulator masks supply the L.P. gas to the diver as he needs it.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
7. Chamber Control System	Diagram one and two-way supply and exhaust on C/B, or use transparency/chart.	
a. All Navy chambers are equipped with a dual system of control valves.		
(1) The "Two-Way" control valves allows operation of the chamber from both inside and outside.		
(2) The "One-Way" control valve allow operation from outside the chamber only.		
b. The two-way control system allows maximum flexibility in chamber operations.		
(1) Allows inside operator to control descent as he is in the best position to monitor patients/passengers.		
(a) Equalizing of pressures.		
(b) Relief depth during treatment.		
(c) Observing for possible pressure intolerance.		
(2) Upon reaching desired depth, outside		

tender can shift to one-way system. Show shift from two-way to one-way control on C/B, transparency or chart.

(a) Frees inside tender to concentrate on patients/passengers.

(b) Places burden of decompression/ treatment on topside personnel.

c. One-way control is for outside tender use in controlling ascent.

d. Chamber "Stand-by" position.

(1) Chamber valves are always in the stand-by position when the chamber is <u>not</u> <u>in</u> <u>use</u>.

(a) Provides for rapid descent in the event of an emergency.

(b) Standby position is same for all Navy chambers.

(2) Outside the chamber: Illustrate

(a) All one-way valves - closed

(b) All two-way valves - open

(3) Inside the chamber

(a) All two-way valves - closed

(b) Equalization valves closed

B. Recompression Chamber Safety and Maintenance

1. High Pressure air increases the possibility of fires and explosion.

a. A chamber fire can grow up to 6 times faster under pressure.

b. Extreme caution must be taken whenever chamber is operating.

(1) No fire or fire producing material.

(a) Matches or lighter

(b) Lighted cigarettes, cigars, pipes or any open flame.

(c) No portable electric appliances regardless of power rating.

(2) Exclude all unnecessary combustible material.

(a) Volatile hydrocarbon liquids with low flash points such as:

1. Gasoline

2. Alcohol and alcoholic solutions

(b) Oils or combustible lubricants which may combine explosively with oxygen under pressure.

(3) Have passengers remove static-inducing clothing prior to entry into the chamber.

(a) "Double Knit" Synthetic garments

(b) Nylon or Wool

(c) No shoes worn at any time

(4) Provide the chamber with flame proof bedding material.

(a) Only that which is necessary

(b) No wool or synthetic blankets

(5) Insure that there are no chemical fire extinguishers inside the chamber.

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
c. Keep water and sand buckets inside the chamber.		
d. Keep "Warning" signs posted in full view of occupants.		
2. Chamber Maintenance		
a. Planned Maintenance System (PMS) includes Recompression Chambers.		
b. Chamber Painting		
(1) Only one coat of paint on inside.	FSN's on C/B, transparency or chart	
(a) If in doubt, remove old paint.		
(b) Repaint with fire retardant paint only (FSN8010-577-4739 MIL-P-17970) or equivalent.		
(c) Use only one coat of primer (FSN 8010-165-8557 TT-P-645) or equivalent.		
(2) Exterior surface may have one primer coat and 2 coats of white or grey (MIL-E-17972).		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
c. Air systems are also on PMS schedules.		
d. Gauges are checked and tested annually.		
C. Chamber Operation Technique		
1. Pressurization Phase	Illustrate on C/B, transparency or chart. May also use actual equipment.	
a. Must have a qualified tender inside during any chamber operation:		
(1) Salvage or HeO2 Diving Officer		
(2) Master Diver		
(3) Diving Medical Officer		
(4) Medical Deep Sea Diving Technician HM8493,8492,8493/5311.		
(5) Saturation Diver or First Class Diver.		
b. Passengers must remain in an uncramped comfortable position.		
c. Patients should be lying in the prone position whenever possible.		
d. The hatch is secured with "dogs" on the doors.		

2096

e. The tender ascertains that all riders are "ready to leave the surface" and notifies the outside tender of the fact. (In case of emergencies, i.e. gas embolism, respiratory distress, or insufficiency, this procedure may be eliminated).

f. The inside tender then begins to apply pressure to the chamber.

(1) Observe passengers closely for any difficulty in equalizing pressure.

(2) If difficulty is noted, stop the ascent and come back up a few feet to allow equalization, then continue.

NOTE: If the same individual continually has difficulty equalizing, it may become necessary to place him in the outer lock for removal rather than aborting the entire run.

g. The rate of descent in most cases is 25 FPM, but this may be speeded up or slowed, depending upon the circumstances.

(1) Gas embolism

(2) Respiratory distress

(3) Deep training dives

h. If patient is to breathe oxygen, he should begin doing so before leaving the surface on Table 5 or 6.

i. When the desired depth is attained, the outside tender switches the control system from two-way system to the one-way system by securing the two-way supply valve.

j. Outside tender now has operational control of the chamber.

2. Bottom Phase

a. Ventilation of the chamber

(1) Continuous venting is best but has disadvantages:

(a) Excessively loud; may produce hearing damage.

(b) May be an excessive demand on a limited air supply.

(2) Intermittent ventilation, according to the following requirements is commonly used:

(a) When air or HeO2 is in use:

1. 2 cu ft per minute for each man at rest.

2. 4 cu ft per minute for each man not at rest (e.g.tender)

(b) When oxygen is in use, the exhaled O2 is exhausted through the demand mask directly into the chamber atmosphere, which will lead to high levels of O2 quickly.

1. Use 12.5 cu ft per minute for each man at rest.
2. 25 cu ft per minute for each man not at rest.

(3) Provide standard stock ear protectors for each chamber occupant FSN-2RD-42A1-759-3290-LF50. Insure that a small hole (1/64") has been drilled in each ear piece to prevent possible external ear squeeze.

(4) In chambers where O2 levels can be continuously monitered, provide ventilation to keep O2 level below 22.5%.

(5) Where calculation of chamber ventilation has not been made, a standard rule of thumb may be applied:

(a) Vent one minute out of five when using air.

(b) Vent two minutes out of five when on O2.

(c) Provide maximum air flow through the chamber when venting with this procedure.

(6) Mechanics of Ventilation Demonstrate

(a) Slowly open exhaust valve

(b) Hold depth by opening supply valve.

(c) Increase the volume of air moving through the chamber by continuing to open the exhaust and balancing the depth with the supply valve.

(d) Secure the vent by slowly closing the exhaust valve and the supply valve, while holding depth steady.

b. Before leaving the bottom, insure that the "dogs" are released on the chamber door.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
3. Ascent Phase	Demonstrate	
a. Ascent and all stops are controlled by the outside tender using the one-way control system.		
b. Rate of ascent depends upon the use of the chamber.		
(1) Oxygen treatment tables - 1 fpm		
(2) Air Treatment tables - 1 minute between stops.		
(3) Surface Decompression		
(a) O2 - 20 fpm		
(b) Air - 60 fpm		
(4) Air decompression - 60 fpm		
c. Upon arrival at a decompression stop, ventilate the chamber.		
4. Timekeeping during chamber operations		
a. Outside tender times <u>all</u> evolutions with two stop watches.		
b. Both watches are stopped and started		

at the same time. Do not use one watch for one part of the evolution and one watch for total time of dive.

(1) Start both watches upon leaving the surface.

(2) Upon reaching the bottom, notify log keeper of descent time. Both watches remain running.

(3) When leaving the bottom:

(a) Stop and start both watches.

(b) Notify log keeper of total bottom time.

(4) Control rate of ascent by slowing or speeding up ascent with the one-way exhaust valve.

NOTE: When ascending at one fpm on the oxygen treatment tables, do not slow the ascent to compensate for lost time. Stop the chamber, ventilate, and allow the time to catch up.

(5) Upon arrival at the stop, stop and start the watches, informing log keeper of

elapsed time.

(6) When leaving the stop, again stop and start the watches. Repeat the procedure for each stop.

(7) Upon arrival on the surface, stop the watches and inform log keeper of ascent time from last stop to the surface.

c. Always use 2 stopwatches in case one breaks or stops running.

5. Log and records for chamber operations

a. A log must be kept of any and all events during chamber operations.

(1) Recompression treatments

(2) Pressure and O2 Tolerance tests

(3) Surface Decompression

(4) Any other use of the chamber including chamber and gauge tests.

b. The log must accurately record all events of an operation.

(1) Name, rate, SSAN of all occupants.

(2) Purpose of the operation.

(3) Names of all personnel outside the chamber.

(a) Outside Tender

(b) Diving Supervisor

(c) Diving Officer

(d) Compressor Operators

(e) Any other personnel connected with the operation.

(4) Chronological record of events as they occur.

(a) Ascent, descent, bottom and stop times.

(b) Personnel locking in and out.

(c) Time oxygen breathing started and stopped.

	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
all events		
cupants.	Put example on C/B or use transparency	
side the		
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ents as		
n and		
nd out.		
tarted		

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OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(d) Any information pertinent to the operation.		
(5) All times are received from outside tender, or the individual responsible for timing of events.		
(6) Accurate record keeping is essential as the log is an official document.		
D. Practical Applications of Chamber Operations		
1. The following stations will be manned by students during each chamber run:		
a. Chamber Operator (outside tender)		
b. Phone Talker		
c. Log Keeper		
d. Supervisor		
2. Practical Performance by all students		
a. Chamber Operator	Monitor student activity and assess trainee ability.	1. Check for adequate air supply. a. Primary b. Secondary 2. Pressurize chamber to 60 feet.

2016

2017

1700

		a. Dog doors b. Start watches c. Insure proper seal d. Descent at 75 fpm to 60' using one-way system. e. Inform time keeper of travel time. 3. On bottom, ventilate chamber. a. Use proper ventilation procedures. b. Maintain depth ± one foot. c. Stop and start watches when leaving bottom. d. Inform log keeper of total bottom time.
	For steps 4 and 5, have trainee explain where rates of ascent would be used.	4. Ascend from 60' to 50' at rate of 1 fpm. 5. Ascend from 50' to 40' at 10 fpm. 6. Ascend from 40' to surface at 60 fpm. 7. Inform log keeper of total travel time.
b. Log Keeper	Monitor and assess ability	1. Accurately record all times given by operator. a. LS time from 24 hr clock. b. Add times given to this time so that all time notations in log are by 24 hr clock.
c. Phone Talker		1. Relay all messages going in and out of chamber using primary comm.

GPO 881-278